JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

VOLUME 8 SEPTEMBER, 1941 NUMBER 11

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AERONAUTICAL REVIEW SECTION

SEPTEMBER, 1941

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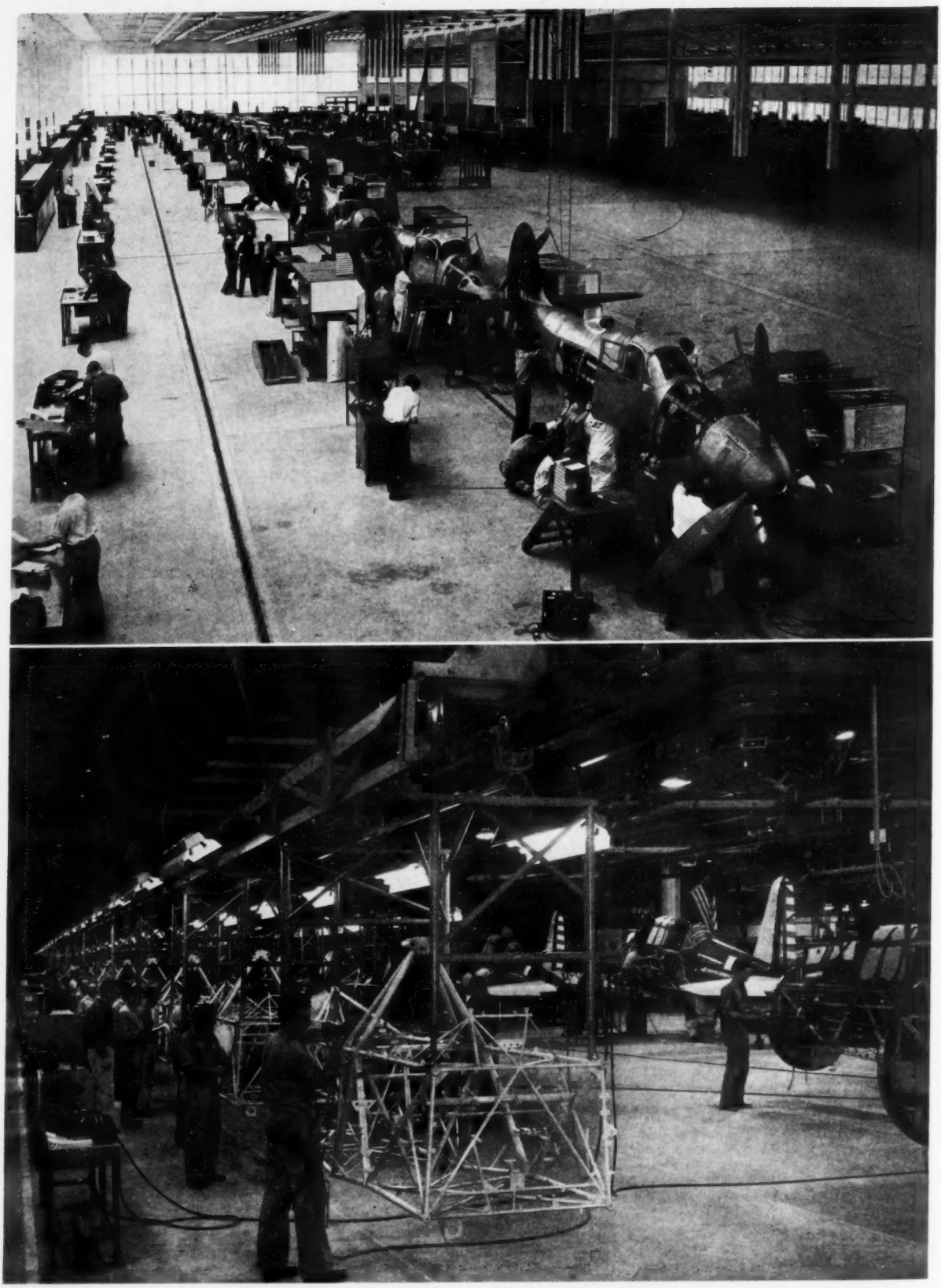

Power assembly lines speed aircraft defense production. At the Bell Aircraft Corp.'s new Niagara Falls plant (above) the endless chain conveyor is sunk into the floor, while at the Vultee Aircraft, Inc. (below) the belt moves overhead.

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AERONAUTICAL REVIEW

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Dear Readers: Respond!

READER ACCEPTANCE of a publication invariably carries with it added responsibility for both publisher and editorial staff. The Aeronautical Review is no exception. Whereas general publications can gage reader interest and acceptance from newsstand sales as well as from letters, technical publications like the Aeronautical Review must depend upon letters and occasional chats with Institute members and the industry at large.

Whether or not this might suffice, we hold that no periodical can grow and develop without a clear and accurate picture of its readers' desires and needs. Reader reaction is the prime necessity to planning improvement. Especially is this true of a publication such as this, the basic function of which is reader service rather than entertainment.

The editors of the Aeronautical Review welcome communications of constructive criticism and suggestions from its many readers—the engineers and designers, and the operations and maintenance executives and workers who depend on the Review to keep abreast of current aeronautical publications and literature. Suggestions as to coverage, treatment, indexing, content and general improvement of its practical usefulness are urgently sought.

We shall continue to use such letters in future planning and policies for the Aeronautical Review, so that its development may keep pace with the rapid growth and progress of the Industry and its contents continue to fulfill the needs and desires of its readers.

Putting Unused Books to Work

The libraries of the Aeronautical Archives of the Institute of the Aeronautical Sciences have been acquired largely through gifts from members. The great Burden Collection of some twelve thousand aeronautical books is on indefinite loan and only a small part of the Paul Kollsman Fund of $50,000 has had to be used so far for the operation of the loan library. It is from gifts of book collections such as the Hanscom, Fairey, Aldrin, Gardner, Loening, Warner and others that the library has grown to its present size of five thousand books available for loaning. Many other members have presented a few books and publishers have sent hundreds of new books for review.

Instead of members keeping on their shelves books which they no longer have occasion to use, they can feel that they are assisting newcomers in the field by donating them to the Archives library. In this way they will have the satisfaction of knowing that these books will be used to benefit others. Such gifts, even duplicates of books already in the library, are gratefully received.

Making Names Stick

As the job of building aircraft for defense spreads out among more and more manufacturers, new names appear on the aviation roster. Some of them are established names, long known in other industries. Others are completely new.

Ultimately, when the emergency is over and the business returns to its normal size, some of these names will vanish and others will return to their original trade. A certain number will remain and become a permanent part of the aeronautical industry.

Just what will determine their fate? The excellence and usefulness of the particular product, the skill with which it is distributed and the service it can continue to render post-war aviation will largely determine whether it will remain or pass out of the picture. Actual records show that these qualities unaided cannot guarantee permanence.

Many of the new companies in aviation made their entry at the bayonet point of defense necessity. They have all the orders they can fill. Their problem is production, not sales. They have, many of them, all they can do to get orders filled and be satisfied that the Government and the Office of Production Management know who they are. But keeping before the public demands continuous explanation, repeated telling.

In aviation, most of the telling is done in trade literature of various kinds. New products and processes are announced in advertisements and releases. New ideas in aerodynamics, structures and methods are presented in the form of scientific papers for group presentation or publication. Catalogues, handbooks of instruction and instruction sheets make it easier for the industry to put the ideas to work.

The ever-increasing quantity and improving quality of information that is being brought forth through these media present a most encouraging outlook for the future of aviation, both as to persistent progress and as to increasing stability. Those organizations which have come into aviation for the emergency and want to keep the toehold they have gained must do more than produce—they must tell about it, and it takes a lot of telling to make a name stick.

News Review

July 11. The War Department announced the autonomous organization of the Army Air Forces to include a separate and independent air force staff as part of the recent program for a semi-independent air force under Major General Henry H. Arnold. Brigadier General Carl Spaatz will act as chief of air staff under General Arnold.

July 12. The House Roads Committee reported favorably on the Cartwright defense highway bill which would earmark $2,000,000 of the defense highway appropriation for experiments with landing strips placed at set intervals along the military highways.

July 13. Aircraft engines totaling 1,700,000 hp. were turned out in June by Wright Aeronautical Corporation's plant at Paterson, New Jersey —an all-time record for the mass production of defense aircraft power plants.

July 13. An 850-acre naval air base for long range patrol bombers was opened at Quonset, Rhode Island.

July 13. Completed negotiations with the Bolivian Government for the nationalization of the German-owned Lloyd Aereo Boliviano were announced by Thomas O. Hardin, head of the first commercial airline commission to Latin-America. Part of the route will be assigned to Panagra, making possible the first coast-to-coast service from Brazil to Chile under American management.

July 14. Major General Henry H. Arnold, speaking at the closing of the Twelfth Annual National Soaring Contest at Elmira, stated that gliders might determine the difference between success or failure in many military missions.

July 15. A report issued by the Civil Aeronautics Authority indicated an increase of 75 airports operating in the U.S., bringing the total number to 2,277.

July 16. The Australian Government, hitherto opposed to the extension of transpacific air service from the U.S. to Australia, indicated its willingness to grant landing rights to the United States in return for similar privileges in this country for an Australian company.

July 17. Ten light airplanes, flown by civilian pilots, took part in cavalry maneuvers at Fort Bliss, Texas. In a statement on the two-day exercises, Major General Innis P. Swift praised the performance of these craft which carried communications when radio channels had been jammed.

July 19. American Export Airlines announced that it intended to begin transatlantic air service this Fall, without an air mail contract, if necessary.

July 21. Brigadier General Donald H. Connolly, Administrator of the C.A.A., reported a total of 82,277 certified civilian pilots in the U.S. on July 1, more than double the number reported a year ago.

July 23. The newly organized Army Air Corps Ferry Command delivered to Floyd Bennett Field in New York several Douglas DB-7 bombers, the first aircraft transferred by the unit.

July 24. President Roosevelt appointed Dr. William E. Durand, professor emeritus of mechanical engineering at Leland Stanford University, to be a member of the National Advisory Committee on Aeronautics.

July 25. The Australian Ministry of Aircraft Production announced that 1,000 Australian-built airplanes would be ready for service by the end of October. The first lot to be completed will be Bristol Beaufort bombers.

July 25. The establishment of passenger service between Glens Falls, N. Y., and New York City was announced by Canadian Colonial Airways.

July 27. The U.S. Army's first organized force of air-transported landing troops, a specially trained battalion available for any hemisphere defense emergency, was formed in the Panama Canal Zone.

July 27. President Getulio Vargas of Brazil formally authorized Panair do Brazil, Pan American Airways subsidiary, to build and improve airfields at eight cities on the Brazilian coast from north of the Amazon River to Sao Salvador.

July 28. Consolidated Engineering Corp. of Pasadena, California, announced its special agreement with the Sperry Gyroscope Company under which it will take over Sperry's work on vibration and strain-measuring equipment.

July 28. William Sholto Douglas, British Air Marshall and youngest commander in the British fighting forces, was knighted.

July 30. In a move to coordinate air and ground forces, the U.S. Army announced the creation of five Air Support commands within the framework of the Air Forces Combat Command. These branches will include observation aircraft, dive bombers, photographic airplanes, gliders, paratroop carriers and troop transports.

July 31. First flight tests of the Vega Ventura, new medium attack-bomber built for the British, were made at Burbank, California.

August 1. Dr. Jerome C. Hunsaker, head of the departments of mechanical and aeronautical engineering at the Massachusetts Institute of Technology, was elected chairman of the National Advisory Committee on Aeronautics to succeed Dr. Vannevar Bush who has become director of the newly established Office of Scientific Research and Development.

August 2. The Office of Production Management granted priority ratings to light airplane builders, permitting them to build 8,000 airplanes during the next twelve months. Recent demonstrations of the military usefulness of these craft, made during recent maneuvers where they were used for artillery spotting and courier service, are said to have prompted the move.

August 2. Johnston and Palmyra Island sites in the Pacific south of Hawaii were announced ready for commissioning as Naval Air Bases.

August 3. Packard Motor Car Company's Aircraft Motor Division began mass production of Rolls-Royce Merlin aircraft engines.

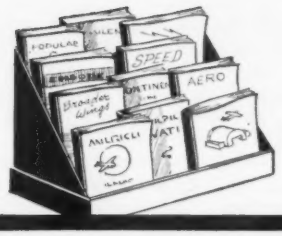
August 5. Tests were begun on a new twelve-cylinder 1,800 hp. liquid-cooled engine at the Ford Motor Company at Detroit.

August 5. Mayor LaGuardia of New York broke ground for a $500,000 seaplane hangar to be occupied by American Export Airlines at La-Guardia Field.

August 6. Pan American Airways opened an air route from Rio de Janeiro to Lima, Peru, replacing Deutsche Lufthansa subsidiaries.

August 8. Pan American Airways

(Continued on page 49)



Periodicals

Aerodynamics

Factors Affecting Elevator Control Forces. George S. Trimble, Jr. This paper presents an analysis and discussion of the factors affecting elevator control forces. The rate of change of elevator stick force with speed is offered as a control force criterion because: first, its value is affected by all the variables associated with longitudinal control; and second, it is easily measured on the full scale airplane in flight.

Since the analysis shows a relationship between this criterion and longitudinal static stability with controls free or fixed, it is also suggested as a longitudinal static stability criterion. Additional flight testing will be required to determine reasonable limits for this criterion. Once established, it should aid the designer in his consideration of longitudinal stability and control. *Journal of the Aeronautical Sciences*, August 1941, pages 401–405.

Zum Luftkraftgesetz der harmonisch schwingenden, knickbaren Platte (Flügel mit Ruder und Hilfsruder) [On the Aerodynamic Law of a Harmonically Vibrating Buckling Plate (Wing With a Control Surface and an Auxiliary Control Surface)]. F. Dietze. Formulas ready to use for the aerodynamic forces and moments of a harmonically vibrating buckling plate in an even flow are extended to the case in which one part of that portion of the plate which is in front of the buckling edge is considered to be a part of the control surface; in combination therewith, arrangements of control surfaces and auxiliary control surfaces with internal compensation are to be taken into account approximately.

In order to make the formulas as handy as possible, some changes are made in jotting down the functions which refer to aerodynamic laws, as compared to the conventional way of writing. This report is limited to small deflections only. *Luftfahrtforschung*, April 1941, pages 135–141, 4 illus.

Die eindeutige Kennzeichnung des Flugzustandes in der Nähe der Min destgeschwindigkeit (Clear Indication of the Flight Altitude Close to Minimum Speed). F. Hoppe. The writer discusses the difficulty of drawing conclusions, from air speed indications of the actual flight altitude, on lifting forces which may be still in reserve. He suggests an observation of the boundary layer conditions by measuring the total pressure on the suction side of the wing. This could be done in combination with the air speed indicator. Several results of wind tunnel tests and flight tests are presented. Questions regarding the practical application are also discussed. *Luftfahrtforschung*, May 1941, pages 198–203, 11 illus.

Kurventafeln zur Abkürzung der Abwindrechnung nach Multhopp und zwei Anwendungsbeispiele (Curve Tables to Cut Down the Time of the Downwash Calculation According to the Multhopp Method, Also Two Explanatory Examples). G. Braun and H. Scharn. The Multhopp calculation method for the downwash on the tail group requires several steps. Determination of the downwash within the breaking away vortical layer takes a long time. Curve tables which are generally valid are presented by means of which the time necessary for the entire calculation may be cut by half. *Luftfahrtforschung*, May 1941, pages 179–183, 6 illus.

Bestimmung der Widerstandsbeiwerte handelsüblicher Runddrahtsiebe (Determination of the Coefficients of Resistance of Screens Made of Commercial Round Wire). B. Eckert and F. Pflüger. In order to synchronize throttle devices in test stands for axial blowers, resistance measurements were made on screens made of commercial round wire. This article reports the results which are of importance to the operation of blower test stands. *Luftfahrtforschung*, April 1941, pages 142–146, 7 illus.

Zur Frage des geraden Sturz- und Gleitfluges bei veranderlicher Luftdichte (On the Problem of a Straight Power Dive or Glide at Variable Density of the Air). Wilhelm Müller. For the calculation of the speed of an airplane at a straight power dive or glide, a method is discussed which takes into consideration the variability of the air with altitude as well as the dependence of the coefficient of resistance on the lift value. *Luftfahrtforschung*, May 1941, pages 174–178, 4 illus.

Ergebnisse einiger systematischer Flugversuche über die dynamische Längsstabilität mit losem Ruder (Re-

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Review or the Institute of the Aeronautical Sciences.

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sults of Some Systematic Flight Tests on Dynamic Longitudinal Stability With Free Control Surface). Rudolf Schmidt. A report on the results of flight tests to investigate the effect of "stabilizing the dynamic pressure" on the dynamic condition of an airplane.

The results show that there is quite a difference as to whether the force which creates the stabilization is a mass force or an elastic force, while static stability is not affected. The "mass-free stabilization of dynamic pressure" was produced by means of a spring which was connected to the elevator across a curved disk in such a way that the introduced moment was independent of the deflection of the control surface.

Tests were made on "stabilization due to mass forces," on "mass-free stabilization" and on "mixed dynamic pressure stabilization." The flight tests showed that mass forces increase the duration of vibrations, while "mass-free stabilization" produced a considerable variation of damping. *Luftfahrtforschung*, May 1941, pages 169–173, 11 illus.

Aerodynamics of Insect Flight. F. W. Lane. An interesting study of insect flight using high speed motion picture photograph. It is shown that Nature's aircraft are, for their respective purposes, considerably more efficient than are the flying machines of Man's creation. They can hover in a breeze and are expert gliders. They can attain maximum velocity from a standing start in a fraction of a second and perform the most intricate acrobatic maneuvers. They fly forwards, backwards, sidewise, and carry unbelievable "payloads." Action pictures of a fly, bee, and dragon fly, are shown. *Aeronautics*, July 1941, pages 50–54, 10 illus.

Accessories

A Differential Control-Unit. F. E. Burger. Description of a variable velocity-ratio unit suitable for inclusion in flying-control circuits of airplanes. Mathematical analysis is provided to assist designers in the accurate production of such a device. Its purpose is to provide a constantly varying gear ratio between cockpit controls and control surfaces. In general it is desirable to obtain a progressive increase in angular change of the control surface as the extremity of the control movement is approached. The unit, made up of a stationary drum, lever and chain driven sprocket, is said to be an improvement over the ordinary differential lever system. *Aircraft Engineering*, June 1941, pages 154, 155, 161, 6 illus.

Switches and Switchboards. E. B. Moss. Discussion of the problem of conserving panel space by regrouping and consolidating instruments. Work in this field being done by Kollsman, General Electric, and Pioneer is outlined, together with developments in special warning devices. *Aeronautics*, July 1941, page 61.

Sperry Hydraulic Exactor Control. A new, simplified remote-control system, recently developed by Sperry Products, Inc., is described. Its particular advantage lies in the positive and accurate control provided and in the fact that the transmitting and receiving unit may be placed any distance apart. It furnishes positive instantaneous control by hydraulic pressure. *Diesel Power*, July 1941, page 597, 2 illus.

Aero-Engine Pyrometer Thermocouples. F. G. Spreadbury. A study of the design, production, inspection and testing of thermo-electric pyrometer equipment. *Aircraft Engineering*, June 1941, pages 156–160, 13 illus.

Airplane Descriptions

Britain's "Snargasher." Description of the Ried & Sigrist Snargasher, a three-place twin-engined midwing monoplane used for the training of R.A.F. pilots in bombing, navigation and night flying. Powered by two De Havilland Gypsy 205 hp. engines, the craft is of wood and plywood construction, with fabric covered wings and tail group. *Aviation*, August 1941, page 111, 2 illus.

The Hawker Typhoon and the Napier Sabre. Paul H. Wilkinson. Description of the new British single place fighter, the Hawker Typhoon. The new craft, basically a development of the Hawker Hurricane, was also designed by Sidney Camm and bears a strong resemblance to the former type. The Typhoon is powered by the new Napier Sabre engine, the 2,000 hp. H-type liquid-cooled engine designed by Major Halford. *Aviation*, August 1941, page 108, 1 illus.

Buffalos at Singapore. At Britain's naval base at Singapore, "hangar after hanger" is filled with Brewster 339 single place mid-wing fighters. This article describes the construction, armament and performance of this American-built fighter, giving dimensions and performance figures. *Aviation*, August 1941, pages 106, 206, 3 illus.

Curtiss SNC-1 Trainer. Description of the new Curtiss SNC-1 combat trainer, a two-place low-wing monoplane powered by a 450 hp. Wright Whirlwind engine. Designed primarily as an advanced trainer for combat pilots it is adapted to gunnery and instrument flying and can be equipped for high altitude work. In case of emergency, this airplane can also be used as a defensive weapon. *Aero Digest*, August 1941, pages 184, 223, 3 illus. Also *Aviation*, August 1941, pages 105, 232, 3 illus.

Curtiss-Wright CW-21-B. A detailed description of this pursuit plane, which is here called "an engine with wings." *Flying*, May 1941, pages 7, 22, 1 illus.

General "Skyfarer." Description of the "Skyfarer," particularly from the standpoint of design. Specifications and performance figures are included. *Southern Flight*, July 1941, pages 24, 25, 2 illus.

The Sportsman Test Pilot. James B. Taylor, Jr. A report on the flying and handling characteristics of the Kinner 160 hp. "Plastic" Timm Trainer. Data are given also on its design, construction and specifications. *The Sportsman Pilot*, July 15, 1941, pages 16, 17, 32, 33, 3 illus.

Fairchild Trainer. In a description of the Fairchild M-62, seven reasons are offered as to why this airplane is "so strikingly right for the job of primary training. The advantages selected as outstanding are the airplane's cantilever low-wing monoplane, its size, weight and power, its visibility, ground handling, wing design, maneuverability and flaps. *Air Force Review*, July 1941, pages 24, 25, 1 illus.

Hurricanes in Canada. A note on Hurricane production in Canada with illustrations of the work at the Fort William plant where the Hurricanes as well as Martin bombers are being turned out. *Air Force Review*, July 1941, pages 10, 11, 8 illus.

The Bristol Beaufort. Specifications and construction details of the Bristol Beaufort. The Beaufort is a mid-wing monoplane of all-metal, stressed-skin construction, and powered by two Bristol Taurus radial engines. The latter are 14-cylinder sleeve-valve, air-cooled units, rated at better than 1,000 hp. each. Beauforts are being built in Australia, and several stages of construction in an Australian plant are shown. *Aircraft Production*, July 1941, pages 254–256, 10 illus.

New R.A.F. Types. Drawings, photographs and descriptive data on the Consolidated B-24, known by the British as the Liberator. The B-24 is a four-engined heavy bomber, powered by Pratt & Whitney 18-cylinder, air-cooled radial engines of 1,200 hp. Maximum speed is well over 300

m.p.h., range 3,000 miles, bomb load 4 tons. *Aircraft Engineering*, June 1941, pages 164, 165, 4 illus.

The Douglas B-19. A review of years of work which went into the building of the B-19. The completed airplane is shown and many of its features are again described. *Flight*, June 19, 1941, pages f–h, 8 illus.

The Martin Marauder. Specifications and some performance data on the Martin B-26, which the British have renamed the Marauder. Powered with two 18-cylinder Pratt & Whitney Double Wasp engines of 1,850 hp., the Marauder is said to have a top speed of 346 m.p.h. *The Aeroplane*, June 27, 1941, page 710, 5 illus.

The Mercurial Master. Description and specifications of the Bristol Mercury powered Miles Master advanced trainer. The Miles Master with the Rolls-Royce Kestrel engine has been used extensively in the advanced training of R.A.F. fighter pilots since the outbreak of the war. However, with a growing number of air-cooled radial-engined airplanes coming from the United States, it was decided to bring out a version of the Master with an air-cooled engine. *Flight*, June 26, 1941, page 434, 2 illus.

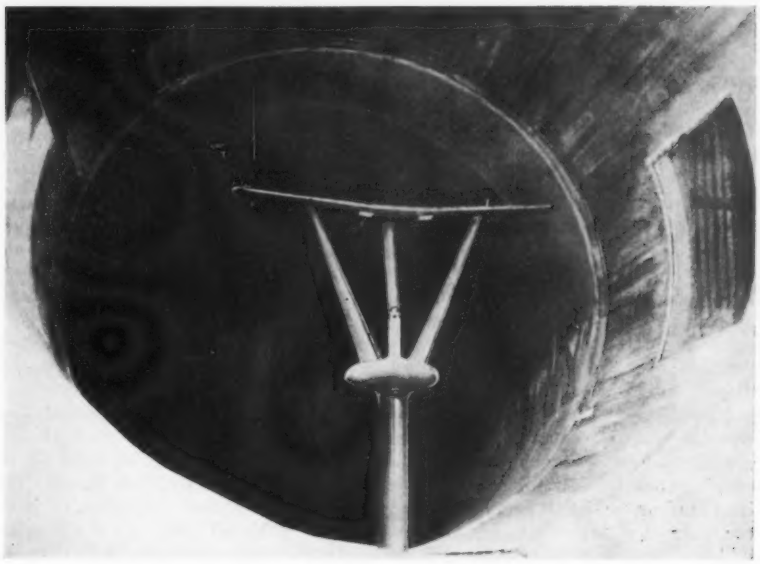
Air Policy

New Route Certificates Under the Civil Aeronautics Act of 1938. George W. Lupton, Jr. An examination of the various factors that may be considered by the Civil Aeronautics Board in its award of domestic new route certificates under the terms of the existing legislation. Foreign air carrier permits are excluded from the discussion.

The governing policy provisions of the Act are explained together with the application (both as to contents and priority in filing) and the hearing. The public convenience and necessity are analyzed from the standpoint of the physical plant and operations, traffic potentialities, financial responsibility, equipment, fares, schedules and competition, as well as the cost to the Government of air-mail carriage and new civil airways.

The rules of evidence, protests and interventions, proceedings after hearing and the legal incidents of the certificate are also treated. The entire study is infiltrated with numerous notes and references to legal precedents and analogies. *Air Law Review*, April 1941, pages 103–152.

Luftherravaldet—Flygvapnet som politisk och militar maktfaktor (Air Supremacy—The Air Force as a Political and Military Power Factor). A review of Douhet's principles of aerial warfare as applied by the Axis powers. Included is a discussion of the start they had on the allied powers in aircraft production, giving them at least an initial advantage. The situation in the Far-East, the Pacific and Africa is particularly stressed. *Flygning*, June 1941, page 6, 2 illus.



The interior of the Northrop wind tunnel at Hawthorne, California.

Civil Aviation and the War. M. de Bunsen. A review of the British Government's expenditures in peace time for various civil air activities, with some of the resulting wartime benefits. Estimated expenditures are given with brief summaries of activities such as flying clubs, gliding, airlines, airfields and commercial training. *Aeronautics*, July 1941, pages 48, 49.

For Lack of a Nail. A suggestion that research be carried forward in cabin design for the purpose of minimizing the dangers and effects of crashes from low altitudes. Possibilities treated include cockpit-padding, belt attached to heavy springs, airframes designed to distribute crash stresses, plastic or hard rubber control columns, as well as special laboratory tests. The latter would determine crash velocities of different types of airplane, and by using dummies and high speed photography, protective measures for safe deceleration, distribution of pressure and avoidance of impact could be designed. *Air Facts*, August 1, 1941, pages 5–7.

Soldiers and Their Airmen. Major F. A. de V. Robertson. A discussion of British defeats due to lack of fighters to cooperate with the Army. The writer states that only four squadrons of fighters were sent to France with the B.E.F.; when the Germans advanced these were reinforced by only two additional squadrons. This in turn was due to budgeting mistakes, by which two bomber squadrons were organized for each fighter squadron, and no provision was made for lending fighters to the Army from the home defense squadrons. It is said that this deficiency in fighters and dive-bombers for the Army is being remedied as speedily as possible. *Flight*, June 26, 1941, pages h, 431.

Airports

A Design for the Airport of Tomorrow. Amy Andrews. A suggested design for a future airport which would eliminate the present "stacking up" on the ground and in the air, caused by an inadequacy of runways. The design calls for a complex dual runway system with the control tower-administration building in the center of the field, connected to the runways by a system of taxi paths. *Aero Digest*, August 1941, pages 92, 93, 3 illus.

Practical Design Considerations of the Canopy-Type Hangar Door. J. I. Byrne. An explanation of the design and operation of the canopy-type hangar door. Suspended by cables attached at intervals midway between top and bottom, along the entire length of the door, the top edge of the door is guided upwards and inwards as the door is raised by the cables. In the open position the door is horizontal, approximately half of it forming a canopy beyond the opening. *Aero Digest*, August 1941, pages 80, 82, 2 illus.

Airports, and the Flying Forties. Robert H. Hinckley. An outline of tomorrow's airport needs by the head

of the Civil Aeronautics Administration. Based upon estimates of the Government and the Industry of about one airplane to every hundred automobiles as a potential figure attainable within the next decade, airport facilities will have to be expanded accordingly. *Aero Digest*, August 1941, pages 56, 86, 1 illus.

The Airport Program Takes Shape. Brig. Gen. Donald H. Connolly. A report on the C.A.A. airport program for the fiscal year which began July 1, 1941. $95,000,000 has been appropriated for new projects and for expansion of existing facilities. *Aero Digest*, August 1941, pages 57, 94.

Establishing Low-Cost Bases for Seaplanes. Cities, states, or counties are now able to sponsor inexpensive seaplane bases consisting of standardized landing float and seaplane dolly, for the cost of materials only. Labor will be furnished through Federal funds. Cost is said to be in the neighborhood of $150 per unit. When completed the base becomes the property of the sponsoring agency. *Aero Digest*, August 1941, pages 59, 61, 3 illus.

Out of the Mud. J. W. Moss. Safety, speed and size characterized the planning and construction of the Washington National Airport, Washington, D. C., whose engineer in charge describes in this article the job that lay before the designers and builders of the newest and one of the most complete landing fields to join the American galaxy. *Airlanes*, August 1941, pages 2, 3, 16, 4 illus.

Standard Runway Marking. Description of a standardized runway marking system developed by the C.A.A. by which runways are marked by magnetic bearing. For example, a runway lying north and south magnetic would be marked 360° (minus the zero) or 36 on the north heading, and 18 on the south. East would be 9, west 27, and so on. On parallel runways the one to the right would be used by incoming ships, and marked with an R under the number. *Aero Digest*, August 1941, page 58, 2 illus.

The Master Plan for Airport Development. A master plan for airport planning. It is said that before an airport is developed, it should be surveyed and laid out in plan form, stage by stage, so that its future size, shape, and layout will be provided for from the beginning. Successive stages in the master plan for a mile square airport are shown. *Aero Digest*, August 1941, pages 60, 61, 4 illus.

Providing Airports for the Private Flier. H. A. Shaffer. A review of recent developments in privately run airports of the country club type. More and more such fields for the exclusive use and enjoyment of private fliers are being opened each year. *Aero Digest*, August 1941, pages 62, 64, 6 illus.

Controlled Approach Lighting. D. S. Little. A discussion of the technical problems of runway lighting to enable transport pilots to make visual contact landings at the termination of an instrument approach. Penetration of different types of lighting is described, together with the design and location of projectors. *Aero Digest*, August 1941, pages 72, 74, 79, 230, 9 illus.

Airport Runways. J. Warren Shoemaker. The problems involved in providing and maintaining rapid transportation and communication so important to industry and national defense are explained in brief by the head of Warren Brothers Roads Company, builders of the runways at the new National Airport, Washington, D. C. *Airlanes*, August 1941, pages 10, 11, 3 illus.

Twenty-Five Years of Airports. Emil K. Harvey. The airport director of Haller Engineering Associates, Inc., describes the great changes that have taken place in the physical appearance and facilities of airports in the United States since the day when any flat field was an airport. The events which inspired these changes are also noted. *Aviation*, August 1941, pages 84, 85, 168, 3 illus.

Omaha's Municipal Airport. Frank S. Gilmore. A detailed account of the preparation and surfacing of runways at Omaha's Municipal Airport. *Aero Digest*, August 1941, pages 67, 68, 71, 227, 6 illus.

Dual Role of the Airport. J. W. Wood. Current events in Europe indicate the increasing importance of well-planned airports for military purposes. In this country, many civil airports are being called on to serve both as commercial and military bases.

This article points out the importance of planning new bases now being built and established bases being reconditioned so that they can serve both as military and commercial airports without becoming obsolescent or unusable after the emergency is over. General rules are given for practical airport layout to serve the dual purpose. *Aero Digest*, August 1941, pages 97, 98, 224, 3 illus.

Speed in Concrete Airport Paving. A. A. Anderson. The speed at which concrete for airport runways can be laid is limited only by the availability of materials, machinery and manpower. This article studies the methods used by contractors who have been successful in completing runway jobs rapidly. It concludes that there is no "best method" for universal use, as this is dictated almost exclusively by local conditions. *Aero Digest*, August 1941, pages 88, 90, 6 illus.

Hiding an Air Base. Martin Green. Description of methods being used for camouflaging the new U. S. air base in Connecticut. *Yankee Pilot*, July 1941, page 11.

Air Transport

Bij het 12½-jarig bestaan der K.N.I.L.M. (On Twelve and a Half Years of Activities of the K.N.I.L.M.) On Nov. 1, 1928, the Dutch East India Airline started its first air transport service. Its network covered two routes, Batavia-Bandoeng and Batavia-Semarang, altogether about 600 km. Today, the network comprises 16,000 km. There are weekly flights with modern transport airplanes over the entire Dutch East Indian archipelago and to Australia and Indo-China. *Luchtvaart*, May 6, 1941, pages 172, 173, 3 illus.

Simpler Cockpit Arrangements Needed. Captain Fred Smith. An airline pilot discusses the need for simplified cockpit arrangements of aircraft controls. It is said that if aeronautical engineers responsible for cockpit arrangements in various aircraft attended the Air Line Pilots Association convention at Chicago each year all concerned would be benefited. It is also stated, that, while qualified airmen agree that with few exceptions the armed services procure the world's finest airplanes from the standpoint of reliability, they also agree that the pilot seems to be the last man considered in engineering a cockpit arrangement. The writer suggests that we might profit by following the British who have done a creditable job of simplification. *Aero Digest*, August 1941, page 54.

Keep Our Transport Planes. A. D. Rathbone, IV. Analyzing the status of air transport in the national defense effort, this article discusses the most urgent necessity of retaining the air transport system in this country intact as a prime essential to the defense effort. *Scientific American*, August 1941, pages 53–56, 4 illus.

Ocean Air Transport. A review of the 29th Wilbur Wright Memorial Lecture, delivered before the Royal Aeronautical Society by Mr. J. T. Trippe, president of Pan American Airways, during his recent visit to London. *Flight*, June 26, 1941, page 433, 1 illus.

Air Transport Progress Through 25 Years. Fowler W. Barker. The secretary of the Air Transport Association recalls associations with and memories of the development of the airlines and the men who made them. *Aviation*, August 1941, pages 68, 69, 170, 172, 174, 176, 16 illus.

Avigation

Eenvoudige Navigatie ten dienste van de Sportvliegers (Simple Navigation for Sport Flyers). J. W. Verhoeven. The previous articles in this series dealt with various types of compasses. This fourth installment discusses compass errors and their compensation. *Luchtvaart*, June 3, 1941, pages 216–218, 8 illus.

Hangar Flying—Notes on Instruments. Elementary observations on the nature of instrument flying, its purpose and uses, and the development of a correct understanding of and attitude toward the use of instruments for blind flying. *The Sportsman Pilot*, July 15, 1941, pages 23, 39, 40.

Business and Finance

Aircraft Cost Control. Gabriel M. Giannini. A study of the application of cost control to aircraft production. Cost control is a scientific medium for balancing quality against quantity. In modern management it permits the gaging of operating efficiency in every manufacturing step. Its application makes it possible to ascertain trends and forecast profits.

In common with all other forms of manufacture, cost control in airplane building requires the establishment of certain standard costs, design for manufacture of a set quantity at a budgeted cost and maintaining manufacturing costs and overhead within the budgeted amounts.

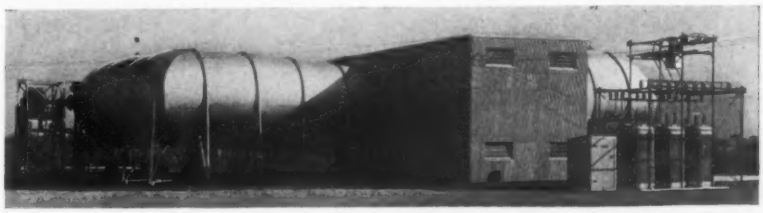
In this article, the principles of cost control are explained in terms of aircraft manufacture, and a specific example of its application is provided. *Aero Digest*, August 1941, pages 187–189, 7 illus.

Air Lines Seek Stability. Selig Altschul. One of the main purposes of the Civil Aeronautics Act of 1938 was to introduce stability and facilitate the healthy growth of commercial air transportation. While a broad policy has been pursued for the most part by the C.A.A. and C.A.B. as regards air-mail rate decisions, a recent examiner's report on the mail rate proceedings of American Airlines virtually asked that American Airlines be required to return alleged overpayment of mail compensation. The writer contends that if the report is concurred in by the C.A.B. it may become virtually impossible for any air carrier to do any future financing. The technical aspects of this situation form the subject of the article. *Aviation*, August 1941, pages 115, 166.

Life Insurance and Aviation. Thomas Burke Carson and John Alan Appleman. An examination of the significance to individuals and the aviation industry generally of the recent withdrawal by leading life insurance companies of all bars upon coverage as to risks of travel incurred by passengers upon established airlines. An analysis is made of the legal interpretations and technicalities incumbent in this liberalized policy of the insurance companies. *Air Law Review*, April 1941, pages 151–163.

Design

Weight Reduction. Edward E. Roberts. A study from the inside of the problems of weights control involved in modern airplane production. The problem of weight reduction involves a close study of materials and vendor-furnished components; having tabulated their weight, these figures should be available for use as a yardstick in actual design.



Exterior of the Northrop Aircraft, Inc., wind tunnel at Hawthorne, California.

With these figures available, it is then possible to keep track of the weight being designed into the airplane by simple bookkeeping. This article outlines the method by which this "stock-control" of weight is established, how it is used by the engineering department and why weight irregularities by outside vendors frequently waste the weight that has been saved by careful engineering and weight control. *Aero Digest*, August 1941, pages 146, 148, 150, 232, 233, 5 illus.

Sheet Metal Drafting. Charles Belsky. The first in a series of articles on drafting for sheet metal work, this installment introduces the history of the subject, indicating its origin in the automobile industry and the basic surface geometry of breaking up a constantly changing surface into a series of component planes, so that the information for the construction of its contour may be given on drawing. *Aero Digest*, August 1941, pages 152, 155, 156, 159, 160, 223, 224, 7 illus.

Problems of Engines Enclosed in Wings. George W. Tweney. The construction of large aircraft with deep wings and the design of flat opposed types of aircraft engines have been brought forward again the idea of housing the power plant entirely within the wing. This type of installation, however, brings with it many new problems in structure, engine installation, cooling and other technical considerations.

This article points out some of the problems that must be solved before this type of installation may be successfully used, and suggests general methods by which good installation, power delivery and cooling might be accomplished. *Aero Digest*, August 1941, pages 142, 144, 224, 4 illus.

Engines

Application of Compression-Ignition Oil Engines to Aviation. V. L. Maleev. An analysis of the technical difficulties or problems which must be solved before a practical compression-ignition oil engine can be built. It is stated that while the work done so far by various engine builders and experimental organizations has furnished enough data to make possible the building of compression-ignition aircraft engines, much development work has yet to be done.

The problems to be solved are set forth with an explanation of hampering factors to date. Potential aircraft engines of the future are indicated with notes on the probable design features of engines in various power groups. It is urged that the aircraft industry and the defense program not overlook the importance of the compression-ignition aircraft engine or further postpone its development. *Mechanical Engineering*, June 1941, pages 446–450, 6 illus.

Tvataktsmotorn som flygmotor (Two-Stroke Cycle Engines as Aircraft Engines). Tore Edlen. The initial article on this subject discusses whether the latest development of aircraft engines is creating favorable conditions for the use of the two-cycle engine. In comparing the two-cycle engine with the four-cycle type as to advantages and disadvantages, the writer gives details on fuel consumption, cooling problems and lubrication problems, direct fuel injection, direct induced gas flow, exhaust gas speed and useful exhaust gas pressure. *Flyg och Motor* (*Technical Supplement*) *Flygning*, June 1941, pages I–V, 3 illus.

Nya metoder for Start av Flygmotorer (New Starting Methods for Aircraft Engines). A detailed description of the "Vict" starting system for aircraft engines. The apparatus consists of a mechanical two-cycle compressor for 50 atm., a hand compressor with automatic control for 50 atm. equipped with a special compressed air tank, and a nine-litre gasoline tank. Drawings are included to illustrate the operation of the system. *Flyg och Motor (Technical Supplement), Flygning*, May 1941, pages VI–VIII, 6 illus.

Twenty-Five Years of Engine Development. C. Fayette Taylor. From a development point of view, 100 years of engine progress has taken place in the past 25 years of aviation. The nature and history of these developments are reviewed in this article. *Aviation*, August 1941, pages 66, 67, 228, 230, 232, 16 illus.

Battle of the Engines. The historical background of today's military aircraft engines is noted as preface to this explanatory account of the more contentious features of modern engine design in the United States. Extensive data are provided in captions with some of the leading American engines illustrated. *Air News*, July 1941, pages 24, 25, 9 illus.

Flygmekanikerns ABC—Nagra vinterproblem (The Airplane Mechanics' ABC—Some Winter Problems). Bertil Bjorkman. The last of a series of articles dealing with the work of the airplane mechanic as a part of the ground organization of an airport.

This concluding article discusses details on the care, inspection and repair of airplanes in winter and particularly notes Swedish winter conditions which necessitate replacing landing wheels with skis. *Flyg och Motor (Technical Supplement), Flygning*, May 1941, pages I–IV, VIII, 16 illus.

Light Aircraft Engine Developments. Harold E. Morehouse. With a brief statement of the beginnings of light aircraft engines as developed for powered gliders, the writer discusses the opposed type as the "much preferred at the present time" and outlines in much detail the present trends of design. The major factors of importance in the design and manufacture of the light airplane engine are set forth, and suggestions are offered as to the future in light airplane engines. *Journal of the Aeronautical Sciences*, August 1941, pages 393–400, 27 illus.

Comparative Performance of Alcohol-Gasoline Blends in a Gasoline Engine. A. R. Rogowski and C. Fayette Taylor. A report of research undertaken to compare the performance of ethyl-alcohol-gasoline blends with the performance of gasoline alone, as fuel for internal-combustion engines. The work was confined to steady-running conditions with engines fully warmed up.

Tests were made to determine optimum inlet temperatures, using a 1934 six-cylinder Chevrolet engine. Optimum compression ratio was determined by tests using a C.F.R. engine with variable compression ratio, and was verified by tests on a multi-cylinder engine. Results of these tests are interpreted and general conclusions of the study are set forth. *Journal of the Aeronautical Sciences*, August 1941, pages 384–392, 14 illus.

Die Bestimmung der thermischen Beständigkeit von verschiedenen Flug motorenölen (Determination of the Thermal Stability of Various Lubricating Oils for Aircraft Engines). M. Richter. Increased requirements on the thermal stability of lubricants made it necessary to determine this stability on some mineral and synthetic lubricating oils. These tests were made in a nitrogen atmosphere (free of oxygen). Variations of the tested lubricants due to a true thermal effect are investigated and discussed. *Luftfahrtforschung*, May 1941, pages 184–197, 9 illus.

Gliding and Soaring

How to Live a Long Time in a Short Time. Major Fred R. Dent. An account of the writer's first experience at piloting a sailplane on instruments. The Schweizer two-place craft, in dual tow by a Waco trainer, encountered some pretty rough weather. The victim writes, "This flight was truly the biggest kick of my career." *Soaring*, May-June 1941, pages 6, 7.

Aalleberg, Swedish Soaring Center. Harald Millgard. The editor of the Swedish aeronautical magazine, *Flygtidningen*, describes the organization and facilities of Sweden's soaring center at Aalleberg. *Soaring*, May-June 1941, pages 4, 5, 3 illus.

Soaring in a Thundercloud. Henry Stiglmeier. The log of a soaring flight made by the writer under hazardous weather conditions. *Soaring*, May-June 1941, pages 3, 5, 1 illus.

Time in Sail. Wolfgang Langewiesche. Part 2 of a lengthy article on gliding and soaring, and many of their problems. The writer stresses the lack of facilities and equipment which makes it extremely difficult to buy solo time on a sailplane. Among other phases of soaring treated are the assisted take-off, rope and release problems, a glider train ride, spot landings and C.A.A. tests, cross-country soaring, and advanced training. An interesting suggestion is also made for adapting the winch method of assisted take-off for gliders to the assisted take-off of heavily loaded transport airplanes. *Air Facts*, August 1, 1941, pages 25–48, 4 illus.

Twenty-Five Years of Gliding. Sherman P. Voorhees. The co-founder of the Soaring Society of America describes the many lean years before new military emphasis on gliding finally led the importance of this phase of flight to be recognized. Newest developments in gliding equipment and skill in this country mark a tremendous contrast to the earlier years. *Aviation*, August 1941, pages 94, 95, 204, 11 illus.

Should U.S. Train Gilder Pilots? An examination of American gliding experience and potentialities in the light of Germany's successful glider operations in the present war. *Air News*, August 1941, pages 12–15, 17 illus.

History

Jaktflygets Renassans (The Renaissance of the Pursuit Plane). A review of the development of the pursuit airplane from 1915 to the present time. Lessons to be drawn from the war in Spain, Poland, Netherlands, Belgium, France, Yugoslavia and Greece are pointed out with regard to the future of this type of warplane. *Flygning*, June 1941, pages 6, 7, 22, 5 illus.

Finishes Without End. Company history of Cellon, Ltd., makers of aircraft dopes and finishes since 1911. The evolution and development of modern finishes are also outlined. *The Aeroplane*, June 27, 1941, pages 704, 706, 7 illus.

Twenty-Five Years of Aviation. Lester D. Gardner. The founder of the oldest American aeronautical publication recalls the birth and early history of the magazine in this guest editorial on the occasion of *Aviation's* 25th anniversary issue. The train of close associates, advisers and editors that followed in the wake of the magazine's beginnings in 1916 brings forth many of the most distinguished and significant names in American aeronautics. *Aviation*, August 1941, pages 48, 49, 188, 3 illus.

Planes and Pilots of World War I. Picture and text recall the military airplane types and the air heroes of the first World War. *Air News*, August 1941, pages 22–25, 31 illus.

Tekniken I Forgrunden (Engineering in the Forefront). A historical review of the development of military airplanes during the last three decades. *Flygning*, June 1941, page 7, 5 illus.

Twenty-Five Years of Airplane Development. Grover Loening. The growth of the airplane over the last quarter-century is traced with key-

notes on successive improvements in design and construction. *Aviation*, August 1941, pages 62, 63, 208, 210, 212, 214, 216, 12 illus.

As We Were. S. Paul Johnston. A former editor of *Aviation* who is now coordinator of research for the N.A.C.A. sets forth random reminiscences of the N.A.C.A. of twenty-five years ago as told to him by Dr. George Lewis, John Victory, Dr. Edward Warner, Dr. William Durand and others of the early organization. *Aviation*, August 1941, pages 64, 65, 184, 186, 188, 5 illus.

AVIATION Has Showed the Way to Greater Achievement Through the Years. A kaleidoscopic reproduction of many articles and editorials from issues of *Aviation* during the last 25 years, showing the publication's leadership in the industry and in service to the industry. *Aviation*, August 1941, pages 74–77.

Condors and Humming Birds. Charles F. McReynolds. The confidential, inside facts on why the West Coast became the promised land for airplane manufacturers is told in this article by *Aviation's* West Coast editor, who describes the development of the west as an aviation center over the past 25 years. *Aviation*, August 1941, pages 80, 81, 178, 180, 182, 188, 14 illus.

Selling Planes in the Old Days. Beckwith Havens. Methods of merchandising airplanes have changed through the past twenty-five years as the airplane itself has improved in usefulness and safety. This article, by one of the few "old timers" still actively engaged in selling airplanes, chronicles the growth of the industry as reflected in changing methods of merchandising aircraft. *Aviation*, August 1941, pages 70, 71, 176, 6 illus.

Instruction

Would You Like to Fly a Douglas? Robert N. Buck. A T.W.A. captain describes the handling characteristics of the Douglas DC-3 transport airplane. Suggestions for taxiing, take-off, climbing and level flight are given, together with a discussion of its stalling characteristics and approach for landing with flaps down. It is said that the power approach is used by airline pilots because the steep, power-off angle of glide with flaps down tends to alarm inexperienced passengers. It also keeps engines warm in winter and prevents their loading up in any weather. DC-3's are landed with the tail up for added control as well as greater smoothness. This prevents a gust or bounce from putting a twelve-ton stalled airplane back into the air for even an instant. *Air Facts*, August 1941, pages 20–24, 1 illus.

Fighter O.T.U. An outline of the final stages in the training of R.A.F. fighter pilots. An O.T.U. (operational training unit) trains on the type of combat airplane to be used later in regular operations. This O.T.U. is equipped with Spitfires, and training includes advanced acrobatics and formation flying, target practice, practice dog-fighting with camera-guns, and instrument flight training. An indoor stationary trainer known as the Hawarden Trainer is described. It simulates the approach of a target, and the student, working from a Spitfire cockpit, is called upon to adjust his sight, get within range, and fire. Life at the O.T.U. and the increasing use of training films are also described. *Flight*, June 19, 1941, pages a–d, 6 illus.

Forge Shop Learners Training Program. John Mueller. An outline of the system developed at Cleveland Hardware & Forging Company for the training of new and unskilled workers for the work of a forge shop. *Heat Treating and Forging*, June 1941, page 273.

School for German Bombers. Pictures from Germany showing one of the schools in which the *Luftwaffe* pilots are trained in the science of bombing. Text and captions describe bombing operations as learned in the German schools. *Air News*, July 1941, pages 14, 15, 9 illus.

C.A.A. Pilot Plus Factor. An outline of the program and current position of the C.A.A. pilot-training plan. Brief, descriptive captions accompany pictures of civilian secondary trainer types used on the C.A.A. program. *Air News*, August 1941, pages 27–29, 14 illus.

Eagle Nest Flight Center. T. W. Ayers. A brief account of T.W.A.'s extensive ferry pilot training project at Albuquerque, New Mexico. Facilities and training routine are noted. *Airlanes*, August 1941, page 8, 2 illus.

Canada Takes to the Air. Frazier Hunt. An account of the British Commonwealth Air-Training Plan and the success of its operations in furnishing more and more pilots for Britain. The cooperation between Canada and the United States both in the matter of pilots and instruction and the furnishing of training equipment is described. *Liberty*, July 26, 1941, pages 26, 27, 39.

Engineering Defense Training. Roy A. Seaton. Noting the magnitude of the engineer's task in the national defense effort, the writer outlines various aspects of the engineering job and cites examples of national needs in engineers. The program of the Engineering Defense Training plan of the U.S. Office of Education is explained in brief with a lengthy statement on the nature and extent of engineering needs, the availability of applicants for training and an imminent expansion of the training program. *Mechanical Engineering*, June 1941, pages 438–440.

Instruments

Effect of Ambient Temperatures on the Coefficients of Venturi Meters. W. S. Pardoe. A paper consisting chiefly of charts showing the results of various tests to determine the effect of ambient temperatures on the coefficients of venturi meters. Brief discussion indicates that there is a distinct effect of ambient conditions on the coefficient of venturi meters and that, unless they are thoroughly lagged during the test and in the permanent installation, they cannot give accurate results under all circumstances. *Transactions of the A.S.M.E.*, July 1941, pages 457–463, 12 illus.

Filling Up the Instrument Panel. Mortimer F. Bates. A comparison between instruments today and those of twenty-five years ago, showing the immense development that has taken place not only in the instrument manufacturing field but in the field of flight training and in man's knowledge of avigation. A short, interesting story of the development of aircraft instruments. *Aviation*, August 1941, pages 90, 91, 192, 194, 196, 234, 15 illus.

The Cox & Stevens Computer. W. S. Alexander. Notes on the navigation problems that crop up in flight requiring calculations which are difficult to make without the assistance of some type of computer. The Cox & Stevens Navigational Computer, an all-around instrument, is described and its uses are noted, with directions and problems for using it. *The Sportsman Pilot*, July 15, 1941, pages 36–38, 1 illus.

Lighter-Than-Air

Blimps Are Back. A brief account of improvements in non-rigid airships for patrol work and of the fleet now being built and the pilots now being trained for lighter-than-air operations. *Yankee Pilot*, July 1941, pages 9, 10, 1 illus.

Waarom naar de Stratosphere (Why Into the Stratosphere)? O. W. P. Mohr. The second in this series of articles treats of the stratosphere flights of Dr. A. Piccard. *Luchtvaart*, June 3, 1941, pages 212–214, 4 illus.

Blimps and Balloons Go Into the Front Line. Hugh Allen. A brief summary of the position of the lighter-than-air craft in modern warfare, viewed in the light of World War I experience and of present-day de-

velopments. The authorization by Congress for airships in the current defense program has revived the status of the balloon in the United States, particularly for defense operations. *National Aeronautics*, June 1941, pages 18, 19, 4 illus.

Materials

Protection of Magnesium Alloys. "Metallurgist." Describing briefly the history and theory of magnesium alloy protection, this article outlines common practice and recent developments and details the properties and fabrication factors of magnesium alloy as related to protective measures and problems. *Sheet Metal Industries*, March 1941, pages 350, 351.

New Fabric Finish Speeds Production. W. T. Smith and A. B. Marsh. A study of recent progress made in the improvement of fabric finishes for aircraft. The structural and production problems involved in any departure are studied from the standpoint of flexibility, permanence, reduction of fire hazard, weight, labor economy and uniformity of material. The methods used for testing new finishes for desirable characteristics are described. *Aero Digest*, August 1941, pages 175, 176, 224, 7 illus.

Production of Seamless Tubes by Combined Effects of Cross-Rolling and Guide Disks. W. Trinks. From the various methods of producing seamless tubes, the writer selected the Diescher elongator mill as the basis of this paper. To furnish an understanding of this method of tube production, the Diescher mill installation at Allenport, Pennsylvania, is described in some detail. The theory of cross-rolling and guide disks in the process of tube manufacture is explained. *Transactions of the A.S.M.E.*, July 1941, pages 411–417, 7 illus.

Mechanical Properties of Materials and Failure in Service. L. W. Schuster. A paper dealing with parts under dynamic loading, chiefly from the standpoint of determining the relative suitability of different materials for service. Particular criteria discussed are tensile strength, yield point, limit of proportionality, percentage elongation, reduction in area, bend test and fatigue. These measures are treated especially in connection with their dependability as criteria for the selection of suitable materials for specific service. *The Engineer*, June 13, 1941, pages 389, 390, 2 illus.

Twenty-Five Years of Progress in Materials. J. B. Johnson. The chief of the Materials Laboratory, Wright Field, furnishes a telling summary of changes during the last 25 years in the methods and accomplishments of the Army's specification, test and use of new materials. *Aviation*, August 1941, pages 86, 198, 200, 202, 216, 4 illus.

Zerstörungsfreie Prüfverfahren für Leichtmetallguss (Damage-Free Testing Methods for Light Metal Casting). G. Kraetsch and A. Scheck. A description of damage-free testing methods for light metal castings. A new testing method which permits especially the detection of micro-cavities (pipes) has been developed. This method may replace the hot oil bath method and even the X-ray method in part.

The castings are pickled for a short time in a solution of 2 per cent ammonium acetate, 15 per cent bichromate of potassium and 83 per cent water. After about one hour, microcavities stand out in a yellow color. *Aluminium*, May 1941, pages 239–246 17 illus.

Aluminium-Echo (Aluminum Review). A German standardization sheet for castings from aluminum alloy ingots is presented. It shows the chemical composition of these alloys and directions as to whether they may be used for sand casting or die casting. Of special interest to the designer are the data on strength characteristics and on the use of the various castings. *Aluminium*, May 1941, pages 231–234.

Self-Locking Nuts. Details of the G.K.N. "Aerotight" locknut used in England. A slight extension of the nut is slotted and each 180° section is again cut, this time parallel with the face of the nut, so that each is held to the nut by about one-third of the section remaining uncut. The free "wings" thus have a locking action somewhat similar to that of a lockwasher. *Aircraft Production*, July 1941, page 233, 3 illus.

Aircraft Materials. J. C. Trewin. Allied and German supply sources of raw materials for aircraft construction, are compared. Production figures on aluminum, steel, cotton, petroleum, rubber, zinc, tin, chromium, lead, nickel, copper, and other key materials are given for allied and axis countries. As the article was written before Germany's attack on Russia, much of it is a discussion of the value of Russia's raw materials to Germany's war effort. *Aeronautics*, July 1941, pages 56–59, 1 illus.

Metallurgy

The Damping Capacity of Metals. An editorial on the "damping capacity" of metals, engineering knowledge of this property to date and its importance to practical engineers. It is indicated that in setting up apparatus for evaluating the damping capacity of a metal unusual precautions must be taken if wholly misleading results are to be avoided. Commenting on recent experiments reported before the Iron and Steel Institute, it is noted that damping capacity is not a specific characteristic of a metal, such as its moduli of elasticity. Its numerical value, even for one particular specimen, is not constant. Consistent results are not obtained until after at least three preliminary runs with the specimen have been made.

Further, its value as deduced from the earlier portions of the oscillation decay curve is not the same as that deduced from the later portions, being in general higher—sometimes two or three times as high—at the start than at the end of the curve. In conclusion it is indicated that much further laboratory and theoretical study is required before the true significance of the damping capacity of a metal can be laid before practical engineers as a quantity. *The Engineer*, June 13, 1941, page 384.

The Damping Capacity of Steel and Its Measurement. G. P. Contractor and F. C. Thompson. Abstract of a report read before the Iron and Steel Institute by the writers—a paper dealing with the nature of the "damping capacity" of a metal and methods for evaluating it. A description is given of the apparatus devised by the writers for measuring damping capacity and of the tests conducted by means of the apparatus. Considerable detail is offered regarding factors influencing damping. *The Engineer*, June 13, 1941, pages 388, 389, 5 illus.

Surface Hardening by Induction. H. B. Osborn, Jr. A paper read before the Electrochemical Society, Cleveland, on the subject of advances in heat-treating by application of induction heating to localized surface hardening. The development of surface hardening by induction is discussed particularly in reference to the widespread applications to which this method lends itself.

Electric induction is analyzed as it applies to surface heating. The metallurgy involved in the induction treatment is discussed and tests showing the carbide diffusion rate and superhardness obtained are described. The equipment used in this type of heat treatment is explained and illustrated. *The Engineer*, June 6, 1941, pages 372, 373, 6 illus.

The Chrome-Hardening of Cylinder Bores. H. Van der Horst. A paper

on the ways in which the application of chromium metal on the cylinder bore affects lubrication and choice of fuel. Tests run in connection with the study are described. The method of application of chromium is discussed at length as to proper bonding to the base material and in relation to the properties of chromium metal as they are good or bad for this purpose. *Mechanical Engineering*, July 1941, pages 536–539, 542, 4 illus.

Developments in Continuous Annealing of Steel Strip. J. D. Keller. With an explanation of the purpose and nature of the annealing process for reducing hardness and increasing ductility, this article launches into an outline of the early continuous annealing processes and the development of current annealing practice, with regard to steel strip. The furnace and cooling zone, handling equipment and the sequence of operations are described. The cleaning, tempering and surface as well as physical characteristics of the strip material produced are discussed. The uniformity and other advantages of continuous annealing are pointed out and the operating cost of the process is analyzed. *Mechanical Engineering*, July 1941, pages 507–513, 7 illus.

Aircraft Problems Dominate Metal Congress. Charles Post. A summary of the Western Metal Congress and Exposition at Los Angeles last June. Concentrating on the problem of how to make the most of the finest metals the country has been able to develop for the aviation industry, the meeting gave an insight into the problems of maintaining production with the limited metallic resources left to those not directly working on defense. Among papers reviewed from the meeting are those on stainless steel, alloy steels, refinery steels, spot welding and magnesium castings. *The Iron Age*, June 5, 1941, pages 55–59, 119, 120, 2 illus.

Ueber die beim Glühen von Al-Si-Legierungen eintretenden Gefügeveränderungen, Ein Beitrag zur Kenntnis des Einformungsvorganges (On Changes of the Crystalline Structure of Al-Si-Alloys During Annealing, a Contribution to the Knowledge of the Fusing Process). H. Röhrig and E. Käpernick. A research report. Systematic annealing tests were made to determine the course of the fusing process of crystalline parts which separate in Al-Si-alloys (with 9 to 13 per cent Si) to which several quantities of Fe, Mn, Cu and Ti were added. Special attention was given to those of silicon and of the Al-Fe-Mn composition.

Results showed that there was no irregular reaction within the selected alloy series. The first changes take place at a temperature of 500°C. and continue even at a temperature of 300°C. The first structural changes of the separated parts on the refined as well as on the unrefined condition of the structure are noticed on the finest points of the crystals. In both cases, the size of separations increases while their number decreases. However, there was no sign that the growth of the larger crystals took place at the expense of the smaller ones.

As silicon dissolves easier in aluminum than the Al-Fe-Mn compositions its fusing process starts earlier than that of the latter. The softening in connection with the fusing is of no importance. It takes place quicker in the unrefined alloy.

During this investigation, observations were made on changes of the crystalline structure at the beginning of the melting. Results showed the formation of melting grooves which at first are threadlike and afterwards broaden out. These grooves form a connection between the separated parts. *Aluminium*, May 1941, pages 235–239, 16 illus.

The Ageing of Aluminium Alloys. Continued notes on the precipitation hardening of aluminum alloys. *Aircraft Production*, July 1941, page 243.

Case Hardening. John F. Wyzalek. The second and concluding part of an article treating of that phase of carburizing which utilizes gaseous media. The nitrogen case hardening process is discussed at length. *Heat Treating and Forging*, June 1941, pages 297–300, 8 illus.

When Bores Must Be Hardened. A. P. Peck. An account of the electromagnetic induction process for hardening wearing surfaces. The process is described and discussed as to its applications and potentialities. *Scientific American*, August 1941, pages 59–61, 4 illus.

Steel Makers Discuss Age Hardening and Drawing Quality of Sheets. A summary report of the technical session of the Iron and Steel Institute meeting in New York, May 22. Among the questions discussed were: What is meant by age hardening of sheets? How important is grain size in the drawing quality of sheets? *Heat Treating and Forging*, June 1941, pages 282–286.

Bibliography on Blast Cleaning With Metallic Abrasives. Ralph Hopp. A bibliography confined to literature pertaining to blast cleaning with metallic abrasives impelled either by compressed air or centrifugal force. It covers all literature on the subject from the time of the invention of the sand-blast in 1870 to April 1940. *Heat Treating and Forging*, June 1941, pages 280, 289, 290.

Meteorology

Registrierballone aus Transparentfolien (Sounding Balloons Made of Transparent Foils). Karl Eisele. Rubber is the material which has been used previously for sounding balloons. Experience has shown that only in exceptional cases do such balloons reach altitudes of 30 km. The writer tries to eliminate all obstacles for the exploration of the stratosphere by means of sounding balloons. He compares the effect of conditions existing in the stratosphere on rubber and on transparent foils. The importance of the effect of low temperatures on these balloon materials is shown in test results. In order to eliminate the destructive action of low temperatures on transparent foils, the writer applies a thin layer of black varnish so they may absorb the radiation of the sun. *Luftfahrtforschung*, April 1941, pages 147–154, 9 illus.

Military Aviation

Belgian Army in Britain. Henry Baerlein. A review of the training and operational activities of Belgian members of the R.A.F. Many Belgian pilots escaped to England from the south of France where they had assembled for re-equipping after the fall of Belgium. These men have served with the R.A.F. and have been joined by hundreds of young Belgians from all over the world. It is said that the Belgians may soon have their own separate squadrons, as more of their pilots from Canadian training centers arrive in England. *Flight*, June 26, 1941, pages f, g, 5 illus.

Fighter Cockpits. Outline of the evolution of fighter cockpits, from the relative simplicity of those in the first World War, to the complexity of instruments and controls found in modern fighters. Drawings of the cockpits of 1914 Avros and today's Spitfires are compared. Instrument and control arrangements of the 1927 Bristol Bulldog and the Parnall Panther, a naval fighter of the last war, are also shown. *Aeronautics*, July 1941, pages 32–35, 6 illus.

Down, But Not Out. A page of pictures and descriptive data on R.A.F. sea-rescue equipment. Different types and sizes of self-inflating rubber dinghies are shown. *Flight*, June 19, 1941, page 416e, 5 illus.

On Preparing for the Charge of the "Lightplane Brigade." A review of the movement to date for adapting light airplanes to problems of modern warfare. Stinson 105's ordered by France arrived too late to prove their worth in actual conflict. Taken over by the British, some of them have been used in England according to stories that have filtered through. Piper light airplanes are being used regularly in England by the Air Transport Auxiliary for ferrying ferry pilots from one job to another. Most recent trial of light craft for wartime service has come in their use during a number of Army maneuvers in late months. The reports of the uses and performance of various types of light airplanes in maneuvers are summarized. *The Sportsman Pilot*, July 15, 1941, pages 12–15, 48, 6 illus.

Military Possibilities of Light Aircraft. Cy Caldwell. A review of military possibilities of gliders, and light airplanes in national defense. It is said that the lightplane is an American institution which should be more extensively utilized in national defense. Experiments in which the Army used light aircraft for artillery observation work against tank attacks, are briefly described. The writer also suggests that experimental work in gliders be speeded by the Army. *Aero Digest*, August 1941, pages 50–52, 4 illus.

Historic Selma, Alabama, Is Site of New Air College. A brief description of the new Advanced Flying School in the southeast, its facilities and program. *Air News*, July 1941, pages 26–29, 24 illus.

USSR, How Big—How Good Is Its Air Force? Lucien Zacharoff. An analysis of the size and quality of the Air Force of the Soviet Union. Little is known of its size, though all estimates indicate considerable unit strength and Russian authorities themselves are said to consider that two armies of nine corps, engaged in an offensive, should have an average of 3,500 combat airplanes—a high ratio in any country. Russia's industrial facilities for production have been reported as greater than our own in 1939, and are considered a source of powerful air strength. It is pointed out that many of Germany's most successful air tactics have been those patterned after original Russian experiments. *Air News*, August 1941, pages 4–9, 25 illus.

The Dutch Fight On. A report on Dutch air activities in continuation of the Netherlands fight for freedom from German occupation. They are now concentrated in the Dutch East Indies. The equipment, liaison and operations of these air activities in the Dutch colonies are noted. *Air News*, August 1941, pages 16–19, 19 illus.

Organization of the U.S. Air Forces. An outline of the reorganization of the air forces of the U.S. Army, with notes describing the background and explaining the significance of the changes reported. *Interavia*, May 1, 1941, pages 1–5.

Bombing by Day. Ed. Amstutz. The writer, who is professor of aircraft construction at the Swiss Federal College of Technology, in Zurich, discusses the series of articles by Chief Engineer Camille Rougeron of the French Navy (published in *Interavia* Nos. 747–749, 751 and 758), who proposed that a new formula be sought for bomber aircraft to enable them to get away from fighters.

This suggestion is analyzed in an endeavor to show that such a type of airplane will remain inferior even when it has achieved the extreme degree of perfection for its dual task. The writer then offers proof of his contention that the clearer the missions allotted to a specific type, the more successfully the machine will be developed and adapted for its specific duties. *Interavia*, May 9, 1941, pages 1–3.

Luftmakterna (Air Forces). A compilation of data on the material resources of air power in the belligerent countries, the United States and Japan. *Flygning*, June 1941, pages 8–19, 28, 38 illus.

The Growth of Army Aviation. A sketch of some of the highlights of Army aviation history depicting the entirely new concept of air power that has grown up in the Army since 1916. Accompanying the article is a message by Major General Henry H. Arnold on "Air Power Then and Now." *Aviation*, August 1941, pages 54, 55, 218, 220, 222, 6 illus.

Radiolocation. Surface description of the development of radiolocation and of the important part it has played in England's air defense system. The device, which works on the principle of radio-wave reflection, enables the R.A.F. to determine numbers and bearings of enemy aircraft formations long before they reach England. Men, fuel and aircraft are not needed for constant air patrols, as radiolocation gives warning in time for fighters to take off and climb to the necessary altitude. It is generally conceded that the Battle of Britain was won by the fighter squadrons of the R.A.F. and the large and intricate combination of radio equipment and trained personnel which makes up the R.A.F.'s system of radiolocation. Radio technicians, it is said, are urgently needed for service with this new branch of the R.A.F. *Flight*, June 26, 1941, pages 430, 431, 3 illus.

Naval Aviation

Anchors A-Weigh. Hogie Ward. An account of a chartered air tour of key military points throughout the United States, sponsored by the Navy for visiting naval experts from Latin America. The projected flight extended over 10,000 miles and lasted for three weeks. Some of the points visited and a number of personalities included in the party are mentioned. Unique aspects of arranging the tour are described. *Airlanes*, August 1941, pages 4, 19, 21, 1 illus.

A Quarter-Century of Naval Aviation. Rear Admiral John H. Towers. The Chief of the Bureau of Aeronautics, U.S. Navy, traces the history of naval aviation in the United States from a time when the Navy had "just one Naval Air Station, a few airplanes and even fewer pilots" down to today's rank as "the most efficient air arm of any fleet in the world, with patrol and combat squadrons with every unit of the fleet, and with air stations from Alaska to Panama and from the North Atlantic Coast to the far reaches of the Pacific." *Aviation*, August 1941, pages 56–58, 234, 9 illus.

Flytande Baser (Floating Bases). A description of the English airplane carriers and how they have been applied in the present war. A table shows the airplane carriers of England, Germany, France, Russia, the U.S. and Japan. *Flygning*, June 1941, pages 22, 23, 26, 4 illus.

Personalities

Capt. Edward V. Rickenbacker, America's Happiest Air Hero. A personalized sketch of the man who has been called America's number one ace of the World War and is now president of Eastern Airlines. The biographical account is accompanied by pictured highlights in Rickenbacker's career. *Air News*, August 1941, pages 20, 21, 39, 9 illus.

Mannen Bakom Luftmakterna (The Men Behind the Air Forces). Biographies and photographs of the military leaders of the air forces in Germany, Italy and England, as well as political leaders, aircraft designers and manufacturers of these countries. The outline includes biographies of Charles A. Lindberg, General Henry Arnold and General George Brett of the United States Army Air Corps. *Flygning*, June 1941, pages 20, 21, 32, 14 illus.

We Knew Them When. . . Presenting a number of historic photographs of outstanding aeronautical figures whose feats and achievements made historic moments during *Aviation* magazine's first twenty-five years

of publication. *Aviation*, August 1941, pages 50–53, 52 illus.

Air Marshal Sir Richard Peirse. Caricature and career outline of the Commander-in-Chief, Bomber Command, R.A.F. Long an advocate of large-size bombers, he has contributed convincing theses on their tactical and operational value. It is said that service records of heavy bombers such as the Stirling and the Boeing Fortress have done much to prove him right. *Aeronautics*, July 1941, page 60, 1 illus.

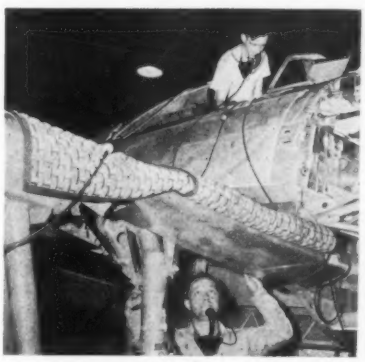
Production

How a Works' Manager Increased His Putput of Anodically Oxidized Aluminum. In analyzing methods for increasing output of anodically oxidized aluminum, it is suggested that any one or a combination of three approaches may be used—alteration of the anodizing conditions using the standard solution, varying the solution and the conditions, and increasing the efficiency of equipment and personnel. An explanation and evaluation of the application and result of these methods in a particular plant turning out aircraft components are explained. In a general consideration of the problem of increasing this type of output, special discussion is given to the care of the solution and the planning of loads. *Sheet Metal Industries*, March 1941, pages 367–370, 5 illus.

Producing Kinner Engines for Primary Trainers. Earl Harring. A description of the alterations in design and production methods used to accelerate the output of light radial engines by Kinner Motors, Inc. The article points out design features incorporated for ease of production, such as one-piece main crankcases, and indicates other changes which have been made to adapt the powerplant design to mass production methods. *Aero Digest*, August 1941, pages 191, 192, 4 illus.

Women's Factory Employment in an Expanding Aircraft Production Program. An interesting study of women's effective employment in aircraft factories is provided in this report which offers suggestions as to how and where women can further fill effective jobs in the aviation industry's defense effort. It is said that a sizable proportion have been employed regularly at such jobs as the fabrication of metals, especially in the production of cutlery and edge tools, hardware, instruments and other metal products. Through such production they have demonstrated their ability to operate satisfactorily at punch presses, drilling machines, milling machines, lathes, grinders and polishers. They have achieved a high record in inspection, assembly of small parts, soldering, filing and other bench work.

The Women's Bureau visited seven aircraft plants assembling bomber, pursuit, observation and training airplanes, making a careful analysis of jobs in relation to their suitability for women. While approximately 100,000 workers were employed in the plants visited, in three there were no women employed and in the other four only a fraction of 1 per cent were women. Those women who are employed are



Workers at the Republic Aviation Corporation's plant save time while working inside aircraft by using a special interphone system to talk with those outside.

working chiefly in the sewing of covers for rudders, ailerons, wing tabs and other control surfaces of the empennage while a smaller number are making parts before painting and doing minor jobs on electrical assemblies, wrapping and identifying gas lines.

In offering specific suggestions as to the expansion of effective employment of women in the aircraft industry, it is estimated that "at least one-fourth to one-third of the jobs in the aircraft assembly plants might be filled satisfactorily by women." *Women's Bureau, U.S. Department of Labor*, May 1941, pages 1–25.

Subcontracting Problems. L. B. Coon. Sperry Gyroscope Company's Planning Manager describes the methods by which his company has met subcontracting problems in its four years of experience with this type of expanded production. The planning of a subcontract program and setting up of a separate organization internally to control subcontracting operations are explained. The planning is essential for determining subcontract requirements and separate internal control provides more thorough regulation of the program.

A systematic and thorough training period for subcontractors is virtually necessary. A flexible system of cost control must be evolved for insuring a fair profit to the subcontractor without requiring lengthy and time-taking negotiations. Close personal contact between both organizations must be maintained to insure delivery and cost control. It is particularly important to accept the subcontractor's internal difficulties as the contractor's own and to lend assistance. *Mechanical Engineering*, July 1941, pages 514–516.

Heat Treating. Norman E. Woldman and Charles H. Fetzer. A study of the application of line production principles to the heat treatment of aircraft metal parts at the Eclipse Aviation Division of Bendix Aviation Corp. Illustrations of the trend toward mass handling of heat treatment are given in the form of two types of Westinghouse gas and electric types of atmosphere-controlled continuous furnaces. In these, the parts are fed in at one end, travel through the furnace at a predetermined speed and are discharged into a quenching tank at the other end without coming in contact with the air.

This article describes the operation of various types of these continuous furnaces, as well as batch type furnaces used for smaller tempering jobs, descaling equipment and special furnaces and methods used in handling aluminum and magnesium alloys. *Aero Digest*, August 1941, pages 163, 164, 167, 168, 223, 224, 11 illus.

Precleaning Aids Spot Welding of Aluminum. V. D. Smith. The writer, of the research department of Oakite Products, Inc., describes some newly developed techniques for chemically cleaning aluminum alloys preparatory to resistance spot welding so that the unavoidable oxide film is fresh or nascent and is of a controlled amount.

The welding difficulty due to the high electrical and thermal conductivity of aluminum alloys is aggravated by the fact that an oxide film always exists at the surface and sets up a resistance at the contact points. The mat finish and mill finish processes for preparing the alloy for welding are described together with the equipment required. The advantages of chemical preparation are enumerated. *The Iron Age*, June 5, 1941, pages 52–54, 3 illus.

Planning for Accelerated Production. Arvid Nelson. The factory manager of Hamilton Standard Propellers describes the company's pro-

gram for expanding its propeller production. The plan was carefully worked out to allow for certain basic considerations such as a new system of control, the elimination of personal opinion from inspection, assuring an adequate, organized source of supervisory personnel, the adoption of a number of new manufacturing methods and advance planning for decreased rate of production. How the program is being accomplished is explained with an analysis of results. *Mechanical Engineering*, June 1941, pages 441–445, 8 illus.

Production Engineering. Earle Buckingham. This paper represents an outline of the principal factors involved in the field of production engineering. The scope of this field is defined. Various phases of the preparation for production are considered, including functional and production design, estimating, operation layouts and schedules, tool design, requisitions and schedules for equipment, the checking of tools and tool-made samples, initial production of a new product, checking the performance of the initial assembled product and investigation and correction of initial troubles.

The subject of production operation and control is treated as to production schedules and follow-up, material procurement and schedules, training of labor, wage incentives, labor relations, quality control, maintenance of equipment, cost reduction, control and budgeting, and correction and development of production design.

The supporting activities discussed are standardization, safety and accident prevention, manufacturing capacity records, factory cost accounting, time and motion study, labor and equipment studies, basic factory planning, process and product development, and performance in the field. *Mechanical Engineering*, June 1941, 431–437, 1 illus.

"Give Us the Tools, America." An analysis of the status of the American aviation industry as regards production in the past, present and future. Information is presented as to production, physical production facilities, and production program. Many references are made to statements by American authorities and to various sources in the American aeronautical press. *Interavia*, May 19, 1941, pages 1–6.

Sunray for War Workers. An account of the successful experiment of Guy Motors, Ltd., in introducing voluntary sunray treatment for employees during working hours. Excellent results are said to have been obtained in the matter of improving the health of employees and reducing absence through illness. *Flight*, June 26, 1941, page 430e, 2 illus.

Amerikansk Luftupprustning (American Air Armament). Prefaced with the caution, "Let us not make the same mistake as last time!" this article reviews the military aircraft production situation in the United States during 1917–1918. *Flygning*, May 1941, pages 6, 7, 1 illus.

Een Oorlogsvogel Wordt Geboren (A War Bird Is Born). The first of a series on the manufacturing methods of Northrop Aircraft, Inc., Hawthorne California, presents a general outline of the subject. Succeeding articles are to deal more in detail with various aspects of production technique employed at this plant. *Luchtvaart*, June 3, 1941, pages 202–206, 7 illus.

Bomber Production. Floor plan and description of the bomber plants being built by the Consolidated Aircraft Corporation at Fort Worth and Tulsa for the production of B-24 heavy bombers. *Aircraft Production*, July 1941, page 259, 1 illus.

Accelerating Production. Arvid Nelson. The plant manager of the Hamilton Standard Propeller Company discusses the problem of increasing output smoothly and rapidly without dislocation of existing production. This abstract of a paper read before the Army Ordnance Association and the American Society of Mechanical Engineers, outlines the procedure by which Hamilton Standard rapidly attained a high peak of production. Problems of space, personnel equipment, and subcontracting are treated. *Aircraft Production*, July 1941, pages 248–250, 6 illus.

Joining Nickel Alloys. Notes on the soldering or welding of Monel, nickel and Inconel sheet. Soft soldering, silver soldering, and brazing are described together with oxyacetylene, arc, flash, spot, and seam welding processes used on these metals. *Aircraft Production*, July 1941, pages 244–247, 9 illus.

The Whitley V. Bruce Foster. The second article of a series on the building of the Whitley V bomber deals with the sub-assemblies of the fuselage. The fuselage is a semi-monocoque structure with longitudinal stringers and transverse frames. It is built in three sections, nose, rear, and stern; the jigging of these sub-assemblies is shown and described. The article has a section devoted to the manufacture of small airframe components, and one on electrical wiring and plumbing. The engine installation is also shown and described. *Aircraft Production*, July 1941, pages 234–241, 29 illus.

Surface Finish. The second in a series of articles on the surface finishing of engine and aircraft structural components. The initial article was a study of honing and its application to engine cylinders and connecting rods. Part two continues with honing practice and its application to a variety of aircraft components. These include the propeller shaft, crankpin holes in the crankshaft, impeller-shaft bearing support, supercharger rear housing, oleo cylinders and wing-flap blind-end cylinders. Different boring and honing machines and procedures are described. *Aircraft Production*, July 1941, pages 227–230, 10 illus.

Time Study. Gordon H. G. Garbett. Contending that many aircraft production shops fail to achieve maximum output due to lack of planning, the writer discusses the reducing of machine fatigue and the saving of time by scientific planning of effort. Machine shop output must be maintained smoothly if long waiting periods in the assembly department are to be avoided. Processes must be planned to avoid delays and interruptions, and it is the duty of the time study department, which is responsible for the coordination of factors involved, to devise the simplest and most economical methods of performing operations.

Absence of planning results not only in inefficiency and bad work, but in fatigue. In fixing the machine time, the first task is to consider the setup. In many cases, the operator wastes valuable time in setting up. Either he is not capable of setting up his own machine, or the rate-fixer has overestimated and given a grossly excessive setting time. This and other possible loop-holes in efficient operation are discussed along with the problem of batch sizes, time analysis, planned working layouts and work elements. *Aircraft Production*, July 1941, pages 231, 232, 5 illus.

Jigging of Modern Airframes—IV. Jigging methods used by British, American, and German aircraft manufacturers. Part 4, a study of the jigging of components and sub-assemblies, covers tail units and shows examples of tail unit jigging by Hawker, Curtiss, Short, Henschel and Junkers, as well as units used in the assembly of the Spitfire and Airspeed Oxford. *Aircraft Engineering*, June 1941, pages 167–170, 19 illus.

Applications of Urea-Formaldehyde Resin Glues. R. Maskew. A study of present day uses of one of the plastic resin glues. Unlike the phenolic resins which can be used in film or sheet form, urea-formaldehyde is applied with a stiff brush or rubber roller. The glue is applied to one of the members to be joined, and a hardening compound to the other. Until the treated surfaces are brought into con-

tact, no setting action takes place Details of application, joining, pressing, as well as characteristics of the glue, are described. *Aircraft Engineering*, June 1941, pages 171, 172, 2 illus.

Twenty-Five Years of Aircraft Manufacturing. Colonel John H. Jouett. The president of the Aeronautical Chamber of Commerce outlines the fabulous growth and expansion of aviation's manufacturing industry, notes the names of companies and individuals who have made that history and points out many of the factors and events responsible for notable changes within the industry. *Aviation*, August 1941, pages 59–61, 17 illus.

Bombers From Mid-America. Part IV. A. M. Rochlen. The fourth article in this series describes the facilities, plant and equipment at Douglas Aircraft Company's fourth airplane factory now nearing completion at Tulsa, Okla. *Southern Flight*, July 1941, pages 14, 15, 6 illus.

Methods Used in Producing the Interstate Cadet. W. Earl Hirtensteiner. In the production of the "Cadet," the only light airplane built on the West Coast, the Interstate Aircraft & Engineering Corp. has circumvented the shortage of factory space and skilled manpower by coordinating engineering with shop tooling.

This has resulted in several innovations in light airplane production, such as the development of a light metal clip for attaching fabric to the structure, subdivision of fuselage welding for accessibility, the use of ready made spars and similar short cuts. By using these and other time-saving shop practices, the plant has achieved a production rate of three airplanes a day, despite the shortage of floor space and manpower. *Aero Digest*, August 1941, pages 179, 180, 244, 9 illus.

Propellers

Bemessung von Luftschraubenflügelfüssen (Dimensions of Propeller Blade Roots). G. Cordes. Data on a calculation which gives simultaneous consideration of dynamic and static stresses at the determination of the dimensions of propeller blade roots. Four distinct stress types are considered, according to vibration hazard and to the purpose for which the propeller is to be used. At a given propeller, these stress types lead to very different permissible engine outputs. The effect of this consideration is applied to dural, elektron and plasticized wood. *Luftfahrtforschung*, April 1941, pages 128–134, 14 illus.

Bemerkungen zum idealen Wirkungsgrad von Schraubenpropellern (Remarks on the Ideal Efficiency of Propellers). Wilhelm Hoff. A propeller is assumed which has an infinite number of blades and operates in a non-frictional fluid which is permanently three-dimensional. The condition of optimum distribution of thrust is applied to the ring elements of this propeller and is to be used to develop an ideal mechanism whose angular velocities are distributed hyperbolically across the blade radius. This mechanism combines also the advantages of uniform distribution of thrust across the blade section, with a minimum loss of slip and rotation.

This ideal propeller is compared with a propeller which has uniform angular speed on all blade elements. The best possible thrust for this mechanism is determined by means of induced efficiency which is uniformly varied across the radius. Finally, the slightly loaded propeller is also mentioned. The relations are explained by means of general curve diagrams. *Luftfahrtforschung*, April 1941, pages 114–121, 12 illus.

Mass production of aircraft spark plugs at General Motors AC Spark Plug Division, Flint, Michigan.

Radio

The Etherial Eye. Brief review of the development of "radiolocation" by means of which the approach of enemy aircraft can be detected without visual detection from patrolling defensive aircraft. This is the equipment for whose operation and maintenance American radio technicians were asked to volunteer for duty in England. It works on the known electrical phenomenon that ether waves when reflected reveal the presence of any solid body which comes within their range. They are not affected by darkness, cloud or fog. It is said that production of the new radiolocators has outstripped the supply of technicians to man and maintain them. *The Aeroplane*, June 27, 1941, page 708, 2 illus.

The Messerschmitt Me 109 Radio. William P. Lear. The president of Lear Avia, Inc., analyzes the radio equipment now being used in one of the most popular Nazi fighters, as revealed by his examination of the equipment in the Me 109 recently inspected by various aviation authorities in the United States. *Aviation*, August 1941, pages 100, 102, 224, 7 illus.

Aviation Radio. Craig Walsh. A description of radio maintenance operations by American Airlines in its radio repair and overhaul shops at LaGuardia Field, New York. The equipment and facilities of the shops as well as routine check, inspection and overhaul practice are outlined. *Aviation*, August 1941, pages 118, 206, 3 illus.

Stress Analysis

Notes on Biot's Dynamic Modulus. W. J. Duncan. A general investigation of the dynamic modulus of undamped systems is given, and simple

general formulas are derived. The modulus is defined in general to be the ratio of the amplitude of a generalized force, *e.g.*, Q_1 to the amplitude q_1 of the corresponding generalized coordinate when all the other generalized forces are zero. The amplitude is that of the steady motion having the same frequency as that of the applied force. Certain dynamic coefficients are zero for flywheel and propeller systems of the type considered by Biot, and then the general formulas reduced to those given by him. *Journal of the Royal Aeronautical Society*, June 1941, pages 225–227.

The Compressive Strength of Thin Aluminum Alloy Sheet in the Plastic Region. J. Robert Fischel. An investigation of compressive stresses of aluminum alloys in the light of the test data available at Lockheed Aircraft Corporation. Compressive properties of aluminum alloys are examined and the stress-strain curves of the alloys concerned are illustrated. Various moduli of elasticity are discussed; the secant and reduced moduli are used in structural equations and a comparison with test data is made to justify the use of these moduli in equations for predicting the strength of flat and curved sheet in compression.

It is concluded that the strength of thin aluminum alloy sheet in the plastic region may be accurately computed by the elastic stability equations if the reduced modulus is substituted for the constant modulus and proper corrections are made for the variations in material stress-strain relationships. It is said that the work presented in this paper indicates that, when more intensive studies are made of the various types of failure, the elastic stability equations may be corrected or expanded to account, at least in part, for the behavior of all types of structure in the plastic region. *Journal of the Aeronautical Sciences*, August 1941, pages 373–383, 23 illus.

Berechnung der Beanspruchung kreisförmiger Ringspante (Stress Analysis of Circular Bulkheads). H. Fahlbusch and W. Wegner. Determination of stresses, such as occur on thin-walled shells and act on circular bulkheads of constant bending stiffness, under consideration of a finite height of the bulkhead section. The analysis is carried out for basic load cases and the result is shown in diagrams. *Luftfahrtforschung*, April 1941, pages 122–127, 19 illus.

Beitrag zur Stabilität dünnwandiger U-Profile mit konstanter Wandstarke im elastischen Bereich (Contribution to the Stability of Thin-Walled U-Profiles With Constant Thickness of the Wall in the Elastic Area). G. Kimm. A report on the buckling of plates with thin-walled U-profile and constant thickness of the wall which are under centric compression.

Two approximate solutions (which are closely related) were developed. The accurate solution was also carried out and the results of these three solutions were compared. This comparison showed that a relatively simple approximation formula is sufficient to secure adequately correct values, even for such a complicated plate problem.

By means of the values derived from the accurate solution, the limits of the buckling area in the region of torsion or in the region of bending were determined. The results show that the walls of thin-walled U-profiles may buckle in some cases. Therefor this theory of buckling of the walls of thin-walled U-profile represents an extension of existing stability theories. (Euler's buckling theory and the torsional buckling theory.) *Luftfahrtforschung*, May 1941, pages 155–168, 14 illus.

Two-Spar Wing Stress Analysis. W. J. Goodey. A paper presenting a theory which gives a reasonable approximation to the stress-distribution in a stressed-skin wing structure. It is said that if there were no skin covering between the spars the load on them would be statically determinate, and the resulting front and rear spar bending moments and shear forces can be found by any convenient method. The effect of the skin covering (where it is effective both top and bottom) will be to superimpose a further system of shears and bending moments, which will have zero resultant at any cross-section. The purpose of this study is to determine this system of loads and moments which must be superimposed, to give the resultant distrubution of loads and moments in the wing. Calculations are simplified somewhat by assuming that all cross-sections are rectangular, the depth of the rectangle being taken about equal to the maximum depth of the wing section between the spars. *Aircraft Engineering*, June 1941, pages 150–153, 4 illus.

Tools and Equipment

Tools for the Workshop. Details and illustrations presented on some new tools produced in England—a light duty electric hand drill in the Wolf series, a Newhall small jig borer and an optical protractor designed for use in accurate measuring by unskilled operators. *Aircraft Engineering*, June 1941, page 175, 4 illus.

Pneumatic Tools. Part III. The third in a group of articles on this subject undertakes a description of rotary tools and many small tools which function without any distributing valve. Among these are valveless hammers, rotor power units, grinders and drills. *Aircraft Production*, July 1941, pages 242, 243, 5 illus.

Modern Machine Tools. A presentation of the latest additions to the range of factory plant in England. Among the equipment described and illustrated are tool grinding, bench drilling cutter grinding, bench turning, band sawing and slot milling tools. *Aircraft Production*, July 1941, pages 251–253, 7 illus.

Shop Equipment and Small Tools. A description of some modern aids to efficient production includes the optical comparator, glazing units, electrical testing equipment, a high-precision micrometer, power-operated jacking equipment, and emergency lighting. *Aircraft Production*, July 1941, pages 260, 261, 6 illus.

Improved Alloy for Metal Stamping Dies. A description of Kirksite and the Kirksite process for the casting of more durable stamping dies than have hitherto been available. The production of stainless steel stampings and cutting operations are discussed. *Heat Treating and Forging*, June 1941, pages 287, 288, 2 illus.

Measurement by Projection. Description of a British micro-projector for measuring and checking machined parts. *Aircraft Production*, July 1941, pages 262, 263, 4 illus.

War Time Output of Rolled Metal Has Demanded Accurate Sheet Mill Control Equipment. H. J. Smith. A discussion of accurate sheet mill control equipment in the light of developments arising out of war-time output of rolled metal for airplanes and tanks. *Sheet Metal Industries*, March 1941, pages 312–319, 326, 9 illus.

Electronic Camera. Description of an electronic vacuum camera that photographs the crystalline structure of substances measured in millionths of an inch in thickness. It was designed to supplement industrial and other X-ray studies. *Scientific American*, August 1941, page 80, 3 illus.

Drop Stamps Help Aviation Speed National Defense. David Hellyer. A review of the various types of work that can be performed to advantage on the drop press. Method of installing a drop hammer, new drop-stamp techniques, forging with various materials and progressive dies are discussed. *Heat Treating and Forging*, June 1941, pages 275, 276, 2 illus.

Invisible Light for Protection Against Sabotage. Paul M. Farmer. An explanation of the methods by which the American District Telegraph System Invisible Ray Alarm

can be applied to the protection of aircraft plants. The apparatus and its operation are described, showing its application to the particular problem of protecting airplane plants against sabotage. *Aero Digest*, August 1941, pages 171, 172, 5 illus.

Advantages of the New Explosive Rivets. D. L. Lewis, Jr. An account of the history of explosive rivets and their use as a solution to the blind rivet problem. This article outlines their construction and the theory of their use, and suggests methods by which they can be applied to the simplification of aircraft production. *Aero Digest*, August 1941, pages 183, 228, 2 illus.

Welding

Welding of Light Aircraft. "Observer." A summary of how welding is being currently used in aircraft construction and an examination of probable trends in its more extensive employment. Methods of both spot and gas welding are outlined, though spot welding is treated more extensively. Considerable attention is given to spot size and spacing, the use of spot welding in fabricating fuel tanks and the control of procedure during the spot-weld operation. A number of jigs for use in welding aircraft components and in assembling welded components are presented by illustration and description. *Sheet Metal Industries*, March 1941, pages 385–391, 18 illus.

Welding Stainless Aircraft Steels. Elemental notes and suggestions on aircraft welding. *Aircraft Engineering*, June 1941, page 176.

Warfare

Towns as Targets. Captain Norman Macmillan. A comparison of the German and British policies of bombing towns and cities. German air policy has been to bomb towns, regardless of their value as military targets, whereas the R.A.F. has concentrated on military objectives. It is intimated that German policy is based on their desire to soften up or destroy towns which might serve as key points of defense against an invasion attempt. The numbers, sizes, and military importance of towns and cities of England and North Ireland are compared to those of Germany. Bombing ranges necessary to reach the latter are discussed. *Aeronautics*, July 1941, pages 38–42, 5 illus.

Hell From on High. Frank Gervasi. An article containing excerpts from the German operational orders for the capture of Crete. They show how the air-borne conquest was carried out. Also presented are British eye-witness accounts of the fierce and incredible battle for the island. *Collier's*, July 26, 1941, pages 11, 12, 29, 32, 2 illus.

R.A.F. in Action. The title of this picture and text description is taken from the book by the same name. The text is condensed from the book and pictures and captions are from *Air News'* own sources. *Air News*, July 1941, pages 4, 5, 9 illus.

British Blast Reich in Night Air Raids. Picture and text description of Britain's night bombing tactics over Germany. *Air News*, July 1941, pages 6, 7, 10 illus.

Miscellaneous

Newspaper Air Correspondence. Major C. C. Turner. Discussion of the problem of maintaining accuracy and absence of distortion in the reporting of aeronautical news. Particular handicaps are said to be the tendency of news writers to make heroes out of airmen who make newsworthy flights and the difficulty many writers have in describing technical facts in non-technical words. *Aeronautics*, July 1941, pages 36, 37.

Douglas inspectors check the 96-in. tires of the B-19 bomber. Each side of the landing gear well is large enough to hold an army scout car.

Site Seeking by Plane. Henry King. A film director for the Twentieth Century-Fox Film Corporation describes how he has adapted the use of an airplane to the job of finding suitable sites for the setting-up of "location" and the "shooting" of moving pictures. He has found it a great time-saver in making quick, accurate surveys. An enthusiast about the potentialities of airplanes for business purposes, the writer urges the building of airplane landing areas in conjunction with new roads in order to provide a great network of unelaborate landing areas to serve defense purposes as well as private aviation. *National Aeronautics*, June 1941, pages 10, 11, 51, 6 illus.

"Steady" Does It Again. A report of the Birmingham Aero Club's National Air Carnival, 1941. News and gossip of events and personalities at the Carnival. *Southern Flight*, July 1941, pages 16, 17, 4 illus.

Organizing Defense Literature. Eleanor Cavanaugh. The librarian for Standard & Poor's Corporation outlines a system for acquisition and organization of the mass of defense literature that is pouring out of government, industrial and press offices. Sources are listed for various types of such published matter and a practical classification is suggested for the cataloguing and handling of such a library. *Special Libraries*, July-August 1941, pages 212, 213, 216.

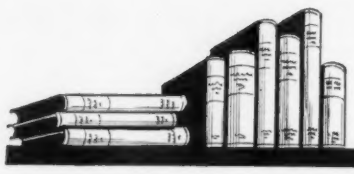
Brittiska Flygets Flotta (British Fleet of Light Craft for the R.A.F.). Description of light power boats which are used as auxiliary craft of the R.A.F. for service repair and rescue work. *Flygning*, June 1941, pages 26, 27, 4 illus.

Aircraft Armament. Construction and operation of the Oerlikon 20 mm. aircraft cannon shell. Its ultra-sensitive nose cap insures detonation at the slightest impact, yet is safe to handle, load and fire. The mechanism of the nose cap is shown and described. *Flight*, June 19, 1941, page 417, 3 illus.

Op Zijpaden der Aviatiek—Het valscherm van vroeger—III (On the By-Ways of Aviation—The Parachute of Yesterday—3). This last in a series of articles on parachutes describes various individual experiences and sensations just prior to and during the parachute jump. *Luchtvaart*, June 3, 1941, pages 219, 220, 2 illus.

Seaplanes. A review of the possibilities of float-equipped light airplanes for the private flier, flying clubs, and flight operators. Airport and hangar shortage problems mean little to the operator or club having some sort of water front available. Seaplane flying is described, together with some of the seaplane bases and activities in and around New York. *Air Facts*, August 1, 1941, pages 8–17, 13 illus.

Corrosion of Fuel Tanks. Condensed version of a paper by E. H. Dix and R. B. Mears on the prevention of corrosion in aluminum fuel tanks. Various alloys used, corrosion-resistant properties, and principal causes of corrosion are discussed together with suggestions for preventative treatment. *Aircraft Engineering*, June 1941, pages 173, 174.



BOOKS

Stress Analysis

The second edition of this standard textbook retains the general character of the earlier work, which has been brought up to date by the inclusion of new theoretical and experimental material representing recent developments in the field of stress analysis and experimental investigation of the mechanical properties of structural materials. Complete derivations of problems of practical interest are given in most cases. In some of the more complicated problems for which solutions cannot be derived without going beyond the limit of the usual standard in engineering mathematics, only the final results are given.

A number of important additions have been made in the revised work: A more complete discussion is provided of problems dealing with the bending, compression and torsion of slender and thin-walled structures. A new chapter is included for the treatment of plastic deformations and deals with the bending and torsion of beams and shafts beyond the elastic limit and with the plastic flow of material in thick-walled cylinders subjected to high internal pressures.

New experimental material is presented on the behavior of structural materials at high temperatures and on the fatigue of metals under reversal of stresses, especially in those cases where fatigue is combined with high stress concentration. Recent results of photo-elastic tests are found in the chapter on stress concentration and additions have also been made to portions of the book dealing with beams on elastic foundations and to the chapters on the theory of curved bars and of plates and shells.

The preface to the first edition states that the book was intended for teaching purposes, and outlines by chapter headings three courses for which it has served as a text. This second edition gives an up-to-date presentation of the subject and will prove useful both to graduate students interested in engineering mechanics and to design engineers dealing with complicated problems of stress analysis.

Strength of Materials. Part II, Advanced Theory and Problems, by S. Timoshenko; 2nd edition, D. Van Nostrand Company, Inc., New York, 1941; 510 pages, $4.50.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

Military Aircraft Explained

In number 44 of the series, *Oxford Pamphlets on World Affairs*, the editor of *The Aeroplane* attempts to explain the complicated structure of modern aerial warfare in layman's language, aiming his explanation chiefly at those who are confused by the necessity for great diversity in aircraft types and for constant change in general design.

Each general classification of aircraft, the fighter, the various types of bombers, torpedoplanes, reconnaissance craft and army cooperation machines are described, their functions explained and their quality compared with parallel German types.

The section on bombing clarifies many points which are frequently hazy to the lay observer. One of these is the reason for the concentration of bombing during the hours of darkness. It is pointed out that the day bomber, flying in any numbers could only be successful in an area completely cleared of enemy fighters by supporting pursuit craft.

Several interesting comparisons between German and British bombers are made. One is that British heavy bombers are armed to defend themselves, while the German craft rely on escort airplanes for protection. In comparing the bomb-releasing techniques, it is noted that, to preserve space, the projectiles in German bombers are carried nose uppermost. This results in several hundred feet of end-over-end tumbling before the bomb assumes its true parabola. Thus German high-altitude bombing has proved less accurate than the R.A.F.'s.

The Military Aeroplane, by E. Colston Shepherd; at the Clarendon Press, Oxford, 1941; 32 pages, $0.15.

Manual of Modern Flying

If there is any doubt remaining as to the tremendous improvement made in flight instruction and flight instruction manuals during the past few years, the second edition of *Air Piloting* will remove it. This text combines much of the excellent training material published by the C.A.A. in separate booklets with the writer's own experience, observations and keen analytical judgment. While it is recommended especially for student pilots, it will be found a valuable reference work both for experienced private pilots and for those preparing for commercial licenses or instructor ratings.

It covers the whole field of flight instruction, including military and civil pilot training, and every attempt has been made to select the approved methods and avoid those outmoded. Approved methods have been carefully analyzed, reduced to essentials, and worked into the latest techniques of pilot development.

The first six chapters take the beginner through the flight curricula upon which the flight test for a private license is based. Included are the ten commandments of safe flying, advice to beginners, introduction to the airplane, preparation for first flight, preliminary instruction, elementary maneuvers, and intermediate maneuvers. Chapters 8 and 9 outline the flight tests for private and commercial pilots; sample ground school written examinations are also given.

Other sections treat of cross-country flying, airways radio, instrument flying, civil air regulations, navigation, meteorology, flight instruction, and a special chapter on seaplane flying. Sample examination questions are given for private and commercial pilots, instructor's ratings, radio-telephone operator's permit, radio and instrument flying, meteorology, navigation, load factors, and Civil Air Regulations. As questions are practically the same as those found on C.A.A. examinations the book will serve both as a handbook and as a comprehensive quiz system. Treatment is simple and clear, and the author shows a deep understanding of student problems.

Air Piloting, by Virgil Simmons; Revised edition, The Ronald Press Company, New York, 1941; 758 pages, $4.00.

Quiz System Revised

The 1941 edition of *Aeronautical Training* has been made necessary by many changes in the Civil Air Regulations, the teletype code and weather broadcasts, according to the author. Other new matter has been added to meet the growing rigidity of examinations for private and commercial pilots.

The manual is in eight parts. The first, on aircraft and the theory of flight, consists of a few pages of summary text and fourteen pages of questions and answers. The sections on aircraft engines, navigation, meteorology and civil air regulations are wholly question-and-answer text, followed by several pages of typical examination questions for private pilots. Part 6 covers general examination questions and answers. The last section furnishes problems and questions on commercial pilot examinations. Various diagrams which may be asked for by examiners are included.

While quiz systems are rarely used as the sole textual material for ground study, they are useful in compiling periodic examinations and are helpful to the student as a review preparatory to his pilot's examination.

Aeronautical Training, by Charles A. Zweng; McKnight & McKnight, Bloomington, Illinois, 1941; 191 pages, $2.00.

Engineers' Annual

As with previous editions of this official publication of the Society of Automotive Engineers, the 1941 *S.A.E. Handbook* contains the current standards and recommended practices adopted by the Society, and supersedes all previous editions.

Standards and other data are arranged in ten sections, each beginning with a title page giving the contents of that section. The "skip" system of page numbering is used to allow for expansion in future editions and to retain the same page numbers for as many of the individual standards as possible in succeeding editions. The dates of original adoption and of last revision are given in notes in small type at the end of each standard or at the end of each principal section of the standard.

Three classes of standards or information data are issued, namely: S.A.E. Standards, or specifications based on established engineering practice; S.A.E. Recommended Practices, or specification based on sound engineering principles and intended as guides toward standard engineering practice; and S.A.E. General Information, data usually bearing on standards or recommended practices that are of sufficient value to warrant publication in the Handbook.

It is impractical to attempt a conventional review of a book of this type. Therefore a brief summary of each Section will suffice to acquaint the reader with the importance and scope of the material contained in the 1941 edition.

Section 1. A review of the dimensional standards for units, parts and finished constructional materials used in aircraft, their component assemblies and in accessory equipment. It also includes descriptive references to the S.A.E. Aeronautical Material Specifications and to the S.A.E. Aircraft Engine Testing Code published separately from this handbook. (77 pages.)

Section 2. The dimensional standards for units, parts and finished constructional material used in automotive apparatus, such as motor vehicles, tractors and motor boats, and in their component assemblies and accessory equipment. (159 pages.)

Section 3. Dealing with processed materials, the specifications for ferrous and non-ferrous metals, and petroleum products that are used in fabricated or finished products, are included in this section. (171 pages.)

Section 4. Standards for fabricated materials, such as conduit and tubing, insulated cable, felt, leather and glass that require further manufacturing operations before they become finished parts or equipment. (30 pages.)

Section 5. The S.A.E. (and American) standards for screw threads, screws, bolts and nuts, and related parts, such as washers, pins and cotter pins. (88 pages.)

Section 6. Tests, Ratings, and Codes—The class of S.A.E. specifications that are complete within themselves, for use in their respective fields. Tests and ratings that are a part of other S.A.E. specifications, such as storage batteries, insulated cable, flexible tubing, etc., are included in those specifications as published in their respective sections of the handbook. (49 pages.)

Section 7. Specifications relating to the operation, servicing and maintenance of motorcoaches and motors trucks, principally in fleets. (20 pages.)

Section 8. Specifications for tools, jigs, gages and for materials and processes for the manufacture of automotive products are included in this section. (13 pages.)

Section 9. This section was originally devoted to nomenclature and definitions relating to automotive apparatus, or to engineering or commercial automotive practices. Before the publication of the 1941 handbook, the Passenger Car Division of the Standards Committee, after careful investigation, decided that there was not enough demand or requirement for a recognized standard to justify the time and effort its development would involve. The Division accordingly recommended omission of part name listings, and have published in their stead fundamental principles and rules for naming automotive parts.

Section 10. The last section includes miscellaneous material, a list of American Standards and the general index. Conversion tables are placed in this section, which also includes S.A.E. specifications and general information relating to them that does not come within the classifications elsewhere.

1941 S.A.E Handbook; Society of Automotive Engineers, Inc., 1941; $2.50 to Members, $5.00 to Non-Members.

Metal Structure Reference Book

Recent strides in the design and fabrication of metal aircraft are reflected in the amount of material which has been added to the fourth edition of *Metal Aircraft Construction.* It is considerably larger than earlier editions and many changes in text and illustration have been made. Obsolete material has been eliminated except where it is of basic technical interest. Much new material relating to current British and American trends has been added.

The history of the development of metal aircraft and the various types of metals and metal alloys used are reviewed. A section on design and structural details of wings contains many drawings illustrating main plane structures as built by leading aircraft companies throughout the world. There are similar chapters on fuselage construction and subsidiary structures, such as tail units, undercarriages, engine mountings and control systems. Special attention is given to flying boat hulls and construction, plant processes and detail design, corrosion and riveting. Tables of specifications and material strength are furnished.

Particulars of aircraft of the belligerent countries are of necessity incomplete. It is indicated, however, that details of later types of German airplanes shot down over England have been carried in the British aeronautical magazines since this revision was completed. It is also noted that descriptions of French, Polish and Czechoslovakian structures stand as they did on the eve of German occupation of those countries. The revised work is well edited and illustrated and should continue to serve its place as a standard reference text.

Metal Aircraft Construction, by Marcus Langley; 4th edition, Pitman Publishing Corporation, New York, 1941; 443 pages, $5.00.

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A British Guide to Aeronautics

In most books written to initiate the average person into the many phases of aeronautics, the attempt is made to popularize or sugar-coat the process with missionary persuasion about the enjoyment of flying itself. The absence of such treatment in *Flight Handbook* suggests how completely aviation has become a part of modern living. This straightforward, elementary text on aeronautics is written for the ordinary individual who wishes to obtain a working knowledge of its many different fields.

The book opens with descriptions of early aircraft and the development of different types of land and seaplanes. A presentation of fundamentals of aerodynamics and aircraft structures is followed by chapters on gliding and soaring, balloons, parachutes, propellers, and instruments. Modern developments in plastics, high-altitude flight, diving brakes, ice prevention, radio, and assisted take-off are summarized in the final chapter. The book is well illustrated, and contains a foreword by Griffith Brewer, president of the Royal Aeronautical Society.

Flight Handbook, by W. O. Manning; 2nd edition, Flight Publishing Co. Ltd., London, 1941; 200 pages, 4*s*.

Ground Engineer's Text

This volume deals with the inspection of aircraft power plants during manufacture, overhaul and tests. It was written expressly for those studying to qualify for the British "D" ground engineer's license, the highest rating. It permits the holder such privileges as turning completed parts for approved equipment instead of installing approved parts fabricated by the manufacturer.

The work outlines the material with which the candidate must be familiar—specifications, standard tests and the general process by which airplane engines are built, overhauled and maintained.

Great stress is laid on inspection procedure both for the engine proper and for power-plant accessories. The section dealing with sleeve-valve engines and Diesels (compression ignition engines) indicates distinctly the difference in approach and attitude of the American and the British mechanic. Appendices provide definitions, conversion factors and other frequently used data.

Aero-Engines, by A. N. Barrett; Sir Isaac Pitman & Sons, London, 1941; 140 pages, 3*s*. 6*d*.

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British and American Engines

The first volume of *Aircraft Engines*, by A. W. Judge, was concerned mainly with the theoretical and experimental aspects of aircraft engines. The present volume is given principally to the descriptive side and to a lesser extent to certain design and theoretical considerations not previously dealt with. Prepared for students, designers, engineers and those engaged in theoretical, practical and experimental work in aircraft engineering, the textual matter of Volume II shows careful selection for practical utility and therefor avoids academic discussions, conjectural subjects and those of a purely theoretical aspect.

The opening portion of the work presents the essentials of thermodynamics of gasoline engines and a practical analysis of the experimental data available on these engines, with a discussion of their design and operation. Types of engines are treated in several chapters which are followed by sections on engine components, lubrication, ignition, exhaust systems, accessories and starting. The testing of aircraft engines is also introduced.

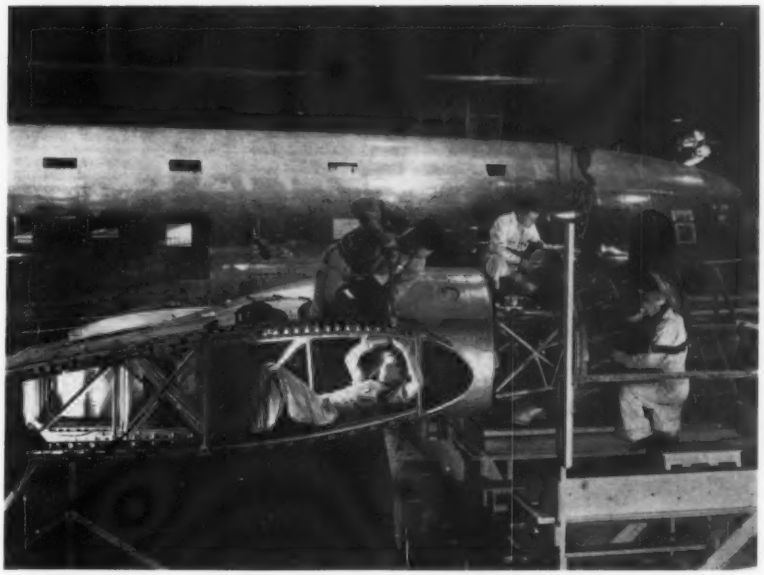
Descriptive sections include accounts of some typical British aircraft engines which were in production prior to and in the early stages of the present war, together with several types of American engines as found on American military aircraft being sent to England. The latest British engines are omitted for military reasons, though it is pointed out that some of the recent disclosures in the American technical press concerning the Rolls-Royce 2,000 hp. Vulture, the Napier Sabre and several others, bear out the conjectures advanced in Chapters 1 and 3.

The coherent organization of material and the many instructive engineering drawings provide an interesting and useful addition to modern literature on the aircraft engine.

Aircraft Engines, Volume II, by A. W. Judge; Chapman & Hall, Ltd., London, 1941; 446 pages, 30*s*.

Aviation Panorama

As a reporter's view of the background, present and future of aviation, the book *Aviation From Shop to Sky* offers a personalized picture of the people who make up the business—the skilled workers, engineers, scientists, mechanics, pilots and dreamers who conceive, build, fly and maintain airplanes. The account was written following a series of visits to air fields and factories, and stresses the human side of the industry.



Completing a Douglas center-section. From *Aviation From Shop to Sky*, by John J. Floherty, J. P. Lippincott Company

The description of activities and operations in a variety of aeronautical plants is illustrated by a number of photographs of the men and machines at work. Among other aeronautical activities outlined are the Army and Navy air services. The career of a mythical flying cadet casts an intimate light on Army Air Corps training as sketched by the writer.

Airlines and airmen, mapping and non-scheduled airplane operation are discussed as commonplace. The visit to New York's municipal airport is recounted in a straightforward description which reiterates the thought that men in industry are more important than instruments, shops or runways. A final section treats broadly the subject of flight and mechanics' schools open to those seeking careers in civil aviation.

Aviation From Shop to Sky, by John J. Floherty; J. B. Lippincott Company, New York, 1941; 215 pages, $2.00.

Radio Navigation

One of a series of small handbooks known as "The Observer's Books" which offer condensed treatments of the various subjects which the R.A.F. observer or navigator must know. This one deals with the fundamentals of radio navigation, being primarily concerned with radio theory, and position-finding by radio triangulation, or cross bearings with loop antenna.

Use of the directional loop, loop errors, quadrantal error, coastal refraction, and methods of calibration are discussed, together with methods for plotting short, medium and long-range bearings. Convergency and conversion are explained, and several types of ground stations described.

The Observer's Book on Radio Navigation, by W. J. D. Allan; George Allen & Unwin Ltd., London, 1941; 106 pages, 2*s*. 6*d*.

Military Aircraft Directory

Another directory of fighting airplanes, considerably less complete than the usual work of its kind, lists the builder, power, purpose and construction of 88 types used in England, Germany, Italy, Poland, France, Holland, Belgium and the U.S.A. Where available, other data provide dimensions, weight and performance, as well as a brief history of the development of the particular airplane.

While the photographs and three-view drawings are strikingly good, the contents belie the title in the amount of space spent on Polish, Belgian and Dutch airplanes, which are no longer fighting, and the number of older types which were obsolete or on their way out early last year. Description of late British, German and American fighters and bombers is entirely missing.

Aircraft of the Fighting Powers, compiled by H. J. Cooper, O. G. Thetford, and edited by D. A. Russell; The Harborough Publishing Company, Ltd., London, 1941; 87 pages, 10*s*. 6*d*.

THE BG CORPORATION
NEW YORK, N. Y.

Flying the Beam

Flying the radio range, as differentiated from instrument flying, is a technique of cross-country air navigation which can be practiced for convenience and added safety by any pilot whose airplane is equipped with a radio receiver. Although it is very apt to be taught and treated as part of instrument flying, it is a distinctly different and separate technique in itself, and can well be learned and practiced under contact-flying weather conditions.

Written by the instructor in charge of American Airlines' Chicago Pilot Training School, *Radio Range Flying* is a brief and non-technical presentation of the subject. Originally published as a series of articles in *The Sportsman Pilot*, new material has been added to complete the text.

The book opens with an explanation of radio aids to navigation and the field pattern of signals which form the on-course range. Cones of silence over the station, multiple courses, swinging beams, and various markers are described, together with methods of beam bracketing. Procedure turns are then shown and explained; the different techniques of orientation are outlined in detail. There is a special chapter on instrument approaches which describes the different stages of approach and let-down.

The conclusion warns pilots to avoid instrument approaches to airports with which they are not familiar and that only constant practice can qualify a pilot to make an instrument approach in real instrument weather. The book is well illustrated and treatment is marked by non-technical simplicity and clarity. It is recommended reading for pilots, students and ground instructors.

Radio Range Flying, by C. H. McIntosh; Ringer Press, Chicago, 1941; 62 pages, $2.00.

Air War Broadcasts

The stories by different types of R.A.F. officers and others which have been compiled from talks given over the British Broadcasting Company facilities make not only fascinating reading but valuable sources for future historians of this war.

Most of the talks are about bombing raids, but training, patrol and rescues are also described. There are so many new expressions used that a glossary of airman's slang would have been helpful. However, the meanings can be guessed and readers will learn new terms used by English pilots.

The remarkable change in attitude of the R.A.F. in permitting its officers to "shout a line" even though it is done anonymously is significant, as it indicates a drive to inform the English public of the daring work done by pilots.

Lord Trenchard, Marshall of the Royal Air Force, who was its real founder and guide for so many years has written a preface in which he says, "I believe that these men would have done anything to have avoided the ordeal of facing the microphone if there had not gone with it a visit to London."

No book gives such a vivid picture of the hazardous work done by the R.A.F., and it will be read by anyone who wishes to familiarize himself with this new form of warfare. Then it will be realized why so much is owed by so many to so few.

The Airmen Speak, by Officers and Men of the R.A.F.; Doubleday, Doran & Company, Inc., Garden City, N. Y., 1941; 299 pages, $2.50.

Production Practice

Many engineers who are today engaged in the various phases of aircraft production have been drafted into the industry from other branches of engineering. In aircraft plants, these engineers have to work with materials such as aluminum alloys, magnesium alloys and special steels which are often different from anything they have encountered in their general engineering work. Also, the processes of aircraft manufacture, though based upon standard engineering practice, differ considerably in detail from those which have formed the basis for standard engineering production work.

Aircraft Production offers a brief survey of materials and methods used in this comparatively new sphere of engineering activity. Without entering too deeply into the detailed manufacturing sequences of any particular aircraft or manufacturing company, the book clearly indicates the relation which each process bears to the production of the completed airplane.

Subject matter has been assembled under eight chapter headings, which include materials, work methods, methods of joining components, assembly, wooden aircraft, aero engines, propellers and notes on the production of a sleeve-valve engine. While most of the material presented is of British origin, treatment is general enough and British and American techniques are similar enough to make it a useful addition to the American production engineer's library.

Aircraft Production, by E. Molloy; Chemical Publishing Co., Inc., Brooklyn, N. Y., 1941; 104 pages, $2.00.

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Letters of an Air Raid Warden

Crown a poet with an air raid warden's steel hat and put him on volunteer duty in wartime London, a city whose peoples and places he knows intimately and loves; let him walk the streets under enemy bombardment; let him breathe the moral and spiritual tonic of unity and faith in a cause; and above all let him see and feel man's unbelievable capacity for courage and compassion—the result is bound to be work with beauty and depth of feeling.

Such a book is *Dusk to Dawn* by an air raid warden. It relates experiences common to most people in England—the pluck, humor and pathos of the immortal Londoner, shelter scenes, the broken home, the ruined church, the shattered business. The author's knowledge of London, his intimate sense of the historic, his feeling for beauty in places and people, combine to make these letters of poignant and lasting value.

Running through them is a vein of the philosophical and spiritual side of British character and an almost naive selflessness which man often exhibits in times of greatest danger. As an example, the author suggests that special provision should be made for members of the R.A.F. after the war—land grants or pensions to show the British gratitude.

Any R.A.F. pilot who gave the suggestion a thought would doubtless reply that from the standpoint of personal comfort, sport and satisfaction it is just plain more fun and a real privilege to be able to do one's fighting in the air. The real gratitude belongs to the anonymous thousands whose self-sacrifice, discipline and hard work make it possible for him to fly and fight. This book is an outstanding account of life in London during the months of heaviest air raids—September and October, 1940.

Dusk to Dawn, by a Warden; Constable and Co., Ltd., London, 1941; 216 pages, 7*s.* 6*d.*

Fundamentals of Instrument Flight

While Lieut. Joseph C. Mackey has named his book *Simplified Instrument Flying,* one of the first points emphasized in his introduction is the fact that instrument flying is not as easy to do as to read about. The reader is warned not to take off in instrument weather under any circumstances without the necessary experience and training, and, it might be added, without having one's qualifications certified by the proper authorities.

On the other hand most pilots, no matter how conservative, once in a while find themselves in situations which at best call for flying wholly or partly on instruments. It is for such emergencies that instrument flying is learned and practiced. When needed, it is apt to be more than urgently needed.

Subject matter is treated simply and briefly with outline headings and subheadings supplanting the usual chapter breakdown. The first part of the book deals with instruments and instrument control, timed turns, and generally introduces the reader to a new and different flight technique. Radio ranges and range flying are discussed together with methods of orientation, procedure turns, weather broadcasts and cross-beam checking. The Link Trainer is also discussed as well as time and distance problems, the safety pilot and abnormal situations such as multiple beams and false cones of silence.

The author has confined himself to brief treatment of important points and for this reason explanations as to how and why a range works, more or less technical procedures and duplicate methods for accomplishing the same result have been minimized.

Simplified Instrument Flying, by Lieut. Joseph C. Mackey; The Aircraft Directory, Athens, Ohio, 1941; 64 pages, $1.00.

Modern Meteorology

Written in response to a demand for a non-technical text to serve the many short and elementary courses in meteorology now being given in the United States, *Introduction to Meteorology* outlines the basic principles of modern meteorology. According to the author, it was written more to create interest and background than to furnish either technical or detailed discussion of the various branches of meteorology. For this reason, the use of calculus in the presentation of meteorological theories is minimized.

A description of the atmosphere and of the instruments used in meteorological observations is followed by a study of evaporation, condensation and precipitation. Adiabatic temperature changes, stability and instability are treated together with temperature variations and their relation to weather. There are chapters on wind systems, air masses, fronts, cyclones and anticyclones, as well as weather analysis and forecasting. Examples of weather maps are given in addition to an outline of the various conversion tables, and a list of recommended textbooks.

While there are ten branches of meteorology listed by the author in the introductory pages, the scope of this book is mainly synoptic, as it is chiefly concerned with the weather processes. Treatment is clear and authoritative for a basic elementary text in meteorology.

Introduction to Meteorology, by Sverre Petterssen; McGraw-Hill Book Company, New York, 1941; 236 pages, $2.50.

Book Notes

Men Only in the Air; C. Arthur Pearson, Ltd., London, 1941; 96 pages, 2*s.* 6*d.*

A compilation of breezy, humorous sketches on various kinds of flight and flying for newcomers to Aviation.

Hell Came to London, by Basil Woon; Peter Davies, London, 1941; 211 pages, 6*s.*

An informative, realistic account of the first fortnight during which London was severely damaged, based on the day-to-day record of the facts as told in the press and in official bulletins, supplemented by the author's own reaction and observation under bombardment.

Index to the Literature on Spectrochemical Analysis, 1920–1939, by William F. Meggers and Bourdon F. Scribner; 2nd edition, American Society for Testing Materials, Philadelphia, 1941; 94 pages, $1.00.

A listing of 1,467 references, comprising a 50 per cent increase in the number of listings in the first edition. Many of the additions cover improved descriptions of atomic spectra, studies of light sources and calibration processes, and conditions influencing the accuracy of quantitative determinations.

America Prepares for Tomorrow, by William Dow Boutwell, B. P. Brodinsky, Pauline Frederick, Joseph Harris, Glenn Nixon and Archie Robertson; Harper & Brothers, New York and London, 1941; 612 pages, $2.65.

An alert factual account of the various aspects of the American defense effort, this collaboration provides information about American resources, both human

and material, and the program for utilizing them in a total defense effort. Aeronautical matter is infiltrated throughout the book and is given no separate treatment.

Fire Defense, edited by Horatio Bond; National Fire Protection Association, Boston, 1941; 220 pages, $1.50.

A compilation of authoritative information analyzing the threat imposed on American homes, cities and industry by incendiary bombs, sabotage and other forms of war incendiarism. Measures to combat this threat are discussed.

Aerial Vagabond, by Bessie Owen; Liveright Publishing Corporation, New York, 1941; 260 pages, $3.00.

A personalized, picaresque account of the author's air safari over England, the Continent, Africa and Asia.

Post D—Some Experiences of an Air-Raid Warden, by John Strachey; Victor Gollancz, Ltd., London, 1941; 135 pages, 3*s.* 6*d.*

A group of short stories depicting the author's experience as a London air raid warden. This is a picture of the air raid warden's tasks and the people who perform them, reported with the vivid simplicity of genuine appreciation and with the restraint of humility.

A.R.P. and All That (and other wartime stories), compiled by C. Kent Wright; George Allen & Unwin Ltd., London, 1941; 130 pages, 2*s.* 6*d.*

Proving that A.R.P., besides performing an essential service, has produced two good things—a sense of comradeship and a sense of fun. A collection of stories, anecdotes and parodies about most of the varied services engaged in civil defense.

The Trackless Way, poems by Leonard Taylor; The Air League of the British Empire, London, 1941; 32 pages, 6*d.*

A booklet of flying poems, mostly short ones. They bear the sometimes wistful, sometimes jubilant stamp so apt to characterize flight-inspired verse. Most of the flying poems in *Night Flight,* by the same author and now out of print, are in this book.

Anti-Aircraft Defense, by C. H. B. Pridham; George Allen & Unwin Ltd., London, 1941; 19 pages, 1*s.* 6*d.*

A handbook for light machine-gunners setting forth the first principles of how to engage low-flying enemy aircraft.

Night and Fire Spotting, by Francis Chichester; George Allen & Unwin Ltd., London, 1941; 68 pages, 2*s.*

A brief, simply written guide for night-spotters, whose job it is to determine whether an approaching airplane is an enemy, whether he or his spotting area is likely to be bombed and whether, as well as where, incendiaries have dropped.

Library Accessions

Air Raid; The Technique of Silent Approach, High Explosive, Panic, by John Langdon-Davies; George Routledge & Sons, Ltd., London, 1938; 142 pages, 2*s.* 6*d.*

Methods of air raid precaution based on a study of the bombing raids made on Barcelona during the Spanish Civil War.

Aircraft Book for Boys, by Dorothy Verrill; Harper & Brothers, New York, 1930; 316 pages, $2.50.

A general book on aviation, sketching briefly the history, design, construction and operation of aircraft, with a glossary of aeronautical terms.

Beginner's Book of Model Airplanes; They Fly! by Carl H. Claudy; The Bobbs-Merrill Company, Indianapolis, 1930; 184 pages.

The principles underlying the construction and performance of model airplanes, including instructions for the building and flying of several elementary types.

Best Flying Stories, edited by Norman Macmillan; Faber and Faber, Limited, London, 1940; 494 pages, 8*s.* 6*d.*

A collection of personal narratives by many famous flyers, describing some of the notable adventures they experienced.

Dynamic Defence, by Liddell Hart; Faber and Faber, Limited, London, 1940; 64 pages, 2*s.* 6*d.*

An analysis of the political and military factors which contributed to the German victories on the European continent.

Flight from Youth, by William E. Barrett; Peter Davies, London, 1940; 214 pages, 7*s.* 6*d.*

A novel about the reincarnation of a young British pilot who was shot down during the first World War.

Gallantry; Its Public Recognition and Reward in Peace and in War at Home and Abroad, by Arnold Wilson and J. H. F. McEwen; Oxford University Press, London, 1939; 498 pages, 12*s.* 6*d.*

The history of the various military and civilian medals and decorations awarded in the British Empire, enumerating the particular deeds of the individual recipients. Some details are also given of the principal awards of other foreign countries.

A Handbook of Empire Timbers, edited by H. A. Cox; H. M. Stat Off., London, 1939; 214 pages, 3*s.* 6*d.*

A reference book giving the source, general description, seasoning, bending and mechanical properties, natural durability, susceptibility to insect attack, preservative treatment, working qualities, uses, and availability of supply of many woods grown throughout the British Empire.

A Handbook of Home-Grown Timbers; H. M. Stat. Off., London, 1939; 87 pages, 2*s.*

A companion volume to *A Handbook of Empire Timbers,* but treating only of those woods grown in the United Kingdom.

An Introduction to D. R. Navigation, by R. W. House and L. St. J. French; Hugh Henry Ltd., Prestwick, Ayrshire, 1940; 30 pages, 1*s.* 3*d.*

Simple explanations and problems for those beginning the study of air navigation by the dead reckoning method.

An Introduction to Wireless Direction Finding, by H. O. MacEachern and A. Tully; House's Air Publications, Prestwick, Ayrshire, 1940; 31 pages, 1*s.* 3*d.*

The elements of wireless direction finding, describing and comparing various systems now employed.

The Practice of Arc Welding, by W. Heigh; Sir Isaac Pitman & Sons, Ltd., London, 1940; 114 pages, 5*s.*

A practical handbook for the man actually engaged in arc welding, covering such subjects as arc processes, faults, procedures, training, distortion and cost.

Relaxation Methods in Engineering Science; A Treatise on Approximate Computation, by R. V. Southwell; 1940; 252 pages, 17*s.* 6*d.*

The application of the Relaxation Method to the solution of problems of structural engineering, mechanical vibration and electrical networks, covering those aspects which are of most importance to the practical engineer.

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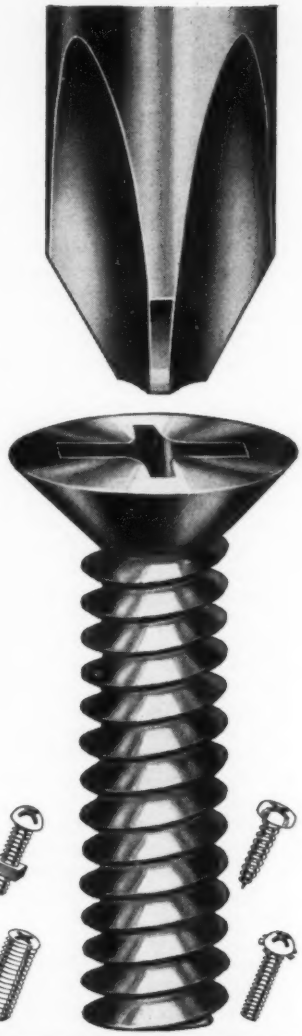

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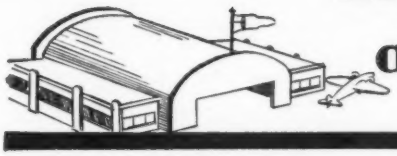


Engine and Flight Instruments

Weston Aviation Instruments. A 30-page catalogue containing descriptions, specifications, installation and wiring instructions, and dimensional diagrams for the electrical tachometers, synchroscope, resistance type carburetor and oil thermometers for single and twin-engined installations, thermocouple type cylinder temperature thermometers and air-fuel ratio indicators.

Among the flight instruments presented are cabin and outside air thermometers, and radio compass and blind landing indicators. Instrument accessories such as thermometer switches and thermocouple leads are also described. *Weston Electrical Instrument Corp.*

Fitting Vibration Problems

Imperial Fittings and Tubing. The problem of eliminating the fitting and tubing failure which results from vibration or tube movement in mechanical equipment is discussed in this 16-page bulletin. It is pointed out that there are three major types of tube movement found in the lines used to carry liquids or gases in practically all modern mechanical devices. These types are said to be minor vibration, major vibration and tube movement.

Each type is defined in the bulletin and the prevention of tubing and fitting failure under each of the three conditions is explained with specific recommendations for the fittings to be used for such elimination. Complete listings of three different types of fittings are given. *The Imperial Brass Manufacturing Co.*

Electric Bond Testers

Two new instruments for testing electrical connections intended to minimize the resistance of mechanical joints are described in a leaflet issued by the *Shallcross Mfg. Co.* One of these units, particularly designed for use in aircraft plants, is called the Aero Gun Model. It is a completely self-contained unit, equipped with a pistol grip. The probes extend through the muzzle, the battery is in the barrel and the indicating meter and control equipment are in the butt. This bond tester can be operated by one man, and an inspector without technical training can do a quick, accurate job of bond testing. The other type of equipment is the standard milli-ohm meter model, contained in a fixed unit. It uses clamp type connections and is read directly from the meter scale.

Lightplane Radios

A folder issued by the *Radio Corporation of America* describes the radio equipment especially designed by R.C.A. for class 1S and 2S aircraft. It includes several types of transmitters and receivers, rotatable loop and trailing antenna systems, microphones, headsets and a simultaneous radio range filter designed for light airplane service.

New Radio Equipment

Ten-Frequency Airplane Radio Equipment. A description of the newly developed ten-frequency transmitters and receiver units, built by Western Electric to operate on ten preselected frequencies in ranges from 300 to 500 kilocycles and from 2 to 15 megacycles.

One of the interesting features of the transmitter design is the method used in shifting carrier frequencies. A Western Electric 5-type quartz plate, which serves to control the carrier frequency, and the various radio-frequency tuning-coils in the transmitter are mounted in a light-weight unit. Ten of these units, one for each preselected frequency, are plugged into position in an aluminum turret, that they may be rotated to bring the unit into contact with the terminal of the transmitter for the desired frequency.

The receiver for the ten-frequency airplane equipment is a superheterodyne type, employing quartz crystals for control of the oscillator circuit. Ten quartz plates and ten sets of tuned circuits are required when the set is fully equipped. *Bell Laboratories Record*, June.

Hardness Tester

A descriptive leaflet on the Ferner Dynamic Hardness Tester model number seven, a compact, self-contained, portable instrument used for testing any metal from tempered steel to lead, linoleum, rubber, vulcanized fiber, ceramics, wood and similar substances.

The tester operates on the dynamic principle. The instrument is simply held against the piece to be tested, and a pendulum hammer is released by means of a pin on the rear of the instrument. Upon striking the surface of the tested material, the pendulum hammer rebounds, carrying the pointer along with it to a point on the scale representing the limit of the rebound, thus giving a reading on the hardness of the material. Scleroscope, Brinell or Rockwell hardness numbers may be obtained with this instrument by a conversion table created for certain materials. *The R. Y. Ferner Co.*

Aviation Alkylates

The Production, Properties, and Use of Aviation Alkylates. H. R. Tate, of the Standard Oil Development Company, outlines the processes and developments in full-scale refinery operations. *The Intava World*, June.

Plastics in Light Airplanes

Technically Speaking. A summary by Sherman M. Fairchild of recent developments in the use of plastic-bonded plywoods in new types of light airplanes. The Libra-Det, a two-place, low-wing primary trainer with a 130 h.p. Franklin six-cylinder engine is shown and various methods of fabricating plastics in aircraft are briefly outlined. *The Air Line Pilot*, June.

Production Technique

Aircraft Production Then and Now. An outline of Bell Aircraft's coordinated lofting technique which has eliminated hundreds of expensive and complicated jigs and thousands of manhours of skilled labor. Flat metal templates are made up for nearly every structural member and the latter are drilled during fabrication for both rivet holes and guide holes so that assembly is vastly simplified. Steps in assembly are described together with the cooperation between the design and construction departments which makes possible the lofting and templating of nearly 100 per cent of the airframe. *The Bell-ringer*, August.

Flexible Shaft Bulletin

Flexible Shafts for Remote Control. An engineering bulletin of 28 pages on the use of flexible shafting for remote control, this booklet provides material on the construction and characteristics of the shafts and a table on the characteristics of various types of control shafting. Typical curves and graphs show the relation between the load on the shaft and torsional deflection.

Methods for working out flexible shaft remote controls are outlined with suggestions for the selection of shafts, the use of gears, the method of shaft attachment and similar considerations. Specifications and details for various types of control shafts are provided. Industrial Division, *The S. S. White Dental Mfg. Co.*

Aircraft Hydraulic Systems

A technical leaflet issued by *Simmonds Air Accessories, Inc.*, presents the Simmonds-Olear high-pressure hydraulic system for main and auxiliary aircraft control functions. This system incorporates a new metallic gland, a leak, oil and temperature-proof pressure seal that makes possible hydraulic systems with operating pressures up to 5,000 p.s.i.

Details on the metallic gland as used in high-pressure systems are provided, along with notes on the advantages of high-pressure hydraulic systems. Comparisons between high and low pressure hydraulic systems, D.C. and A.C. methods for auxiliary power are given. Factors considered include weight, cost, reliability, vulnerability and ease of application to landing gear and flap motivation, trim tabs and cowl flaps, brakes, gun turrets and similar functions.

Accessories Company History

The growth of radio and hydraulic appliances in aircraft construction and operation is outlined in a 38-page booklet on the history of the Aircraft Accessories Corporation of Burbank, which grew from 1,500 sq.ft. of floor space in 1938 to 44,000 sq.ft. at present.

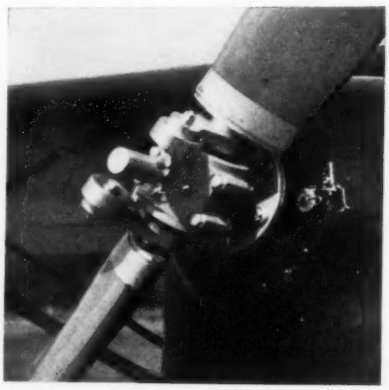
The origin of the company, its officials, equipment and products are presented. A number of illustrations include pictures of the plant in operation. *Aircraft Accessories Corporation.*

Shop Equipment Catalogue

Atlas Modern Shop Equipment. A new 72-page catalogue listing machine shop equipment of various kinds was issued recently by the Atlas Press Co. The equipment included an assortment of lathes, lathe tools and attachments, milling machines, shapers, drill presses and other standard shop equipment. *Atlas Press Company.*

Ferry Transport

Catalina Air Ferry. A brief history of air service between Catalina Island and California. Glenn L. Martin made the first seaplane flight across Catalina Channel from Newport Harbor for a world's distance record over water, May 10, 1912. Ferry service was begun in April 1919. Several companies have operated the line since then. Today Catalina Air Transport flies the route from Wilmington, California, to Avalon with twin-engined Douglas "Dolphin" amphibians. Service will shortly begin with two Lockheed Lodestars replacing the amphibians. *The Intava World*, June.



The hub of the new Everel constant-speed propeller for light airplanes.

Visibility

See Where You're Going. A Bell Engineer who is also a Reserve U.S. Army Air Corps pilot analyzes the importance of visibility in air combat. Military pilots are trained to watch the whole sphere of visibility. The fewer structural blind spots, the better. The necessity for good visibility over the nose is illustrated with an example of a 30° diving attack on the tail of a bomber. From a range of 1,000 yards gunfire must be led or aimed ahead of the target. The Airacobra's sloping nose enables the pilot to lead the target and still be able to keep it in sight. *The Bellringer*, July.

Island Air Routes

Air Transport in the Philippines. A brief review of the development of two air lines which have operated in the Philippines. The Philippine Air Transport Company ended operations in July 1940, having flown more than 2,000,000 miles carrying 33,711 passengers with no accidents involving injury to a single passenger. The remaining line operated by the Iloilo-Negros Air Express Co. Inc. from Baguio to Davao has been in operation since 1933. In February of this year a new company, known as Philippine Airways Inc., was formed in Manila, and plans are being made for operation of a second route between Baguio and Davao, by way of Paracale and Cebu. *The Intava World*, June.

Navy Pilot Training

Pilot Training Program Vital to Naval Aviation. A brief outline of the various training stages in the Navy's pilot training program. Primary students start at one of the 16 Reserve Aviation bases, from which they are sent to Pensacola or Corpus Christi. Here their advanced work is taken and upon completion of the course they are listed as Reserve Officers. As Reserve Officers they are put on active duty. After eighteen months they can apply for permanent commissions. *The North American Skyline*, July.

Hydraulic Exactor Control

The Sperry hydraulic exactor control, applied to aircraft construction as a control system for throttles, superchargers, switches, shutters and similar functions, is described in a recently issued leaflet. The control consists of two elements—a transmitter fitted with a hand lever and a receiver equipped with a lever which follows the hand lever accurately and without loss of motion. The two are connected with a single aluminum tube.

This system, according to the brochure, results in full transmission without mechanical loss of motion or backlash, and is practically self-locking and self-synchronizing. An instruction sheet containing detailed directions for the control's installation and operation is included. *Sperry Products, Inc.*

Distaff Side of Production

A brief review of the many phases of aircraft production work being done by women. Included are fabric-covering, upholstering, rib-stitching, sound-proofing, and the production of miscellaneous parts. *Douglas Airview*, June.

Local Civil Defense

Democracy in Action. Col. J. A. Baer. The officer in charge of civil defense for the 2nd Corps Area of the U.S. Army explains the important place of organized civil defense in the scheme of the national defense effort in a 22-page booklet. It describes measures and methods being used in England and offers a plan for local organization, training and administration. The many problems of civil defense, including air raid protection, are discussed and suggestions are offered on the basis of British experiences in the present war. *Recruiting Publicity Bureau*, U.S. Army.

Hardening Dural

Defense Data from the Houghton Line. Hardening and strengthening aluminum alloys by heat treatment entails distribution of the alloying materials throughout the metal in their most effective form. This 32-page bulletin explains the part that salt baths play in the treating process. It outlines the use of Draw Temp FG, a special salt developed to serve as a one-bath treatment for aircraft aluminum alloys. *E. F. Houghton & Co.*

Welding Torches and Tips

A bulletin on the new Rego aircraft welding torch describes its construction, indicating the ease with which it can be manipulated around jigs and fixtures and into tight corners. Specifications and operating data on various sizes of short and long welding tips are also provided. *National Cylinder Gas Company.*

Forest Fire-Fighting

Aircraft Industry Aids Forest Defense. J. C. Kern, of the U.S. Forest Service, describes modern methods of forest fire-fighting and prevention using aircraft and parachute equipment. Airplanes are used for patrol, scouting and mapping a blaze and its probable course. Transports are also used to supply ground fire-crews with food and supplies and to drop parachutists equipped with special suits and fire-fighting equipment, including two-way radio for communication between ground and airplane. Experiments are being carried out by the Forest Service in low-altitude bombing to check the path of a fire. This requires extreme accuracy for it corresponds to blasting a fire break or open cut across the path of the blaze. *The Consolidator*, July.

Speed Nut Data Book

Speed Nuts for Aircraft. Speed nuts and other attaching devices applying the spring tension principle have been introduced into aircraft manufacture only after demonstration of their ability to resist vibration. A loose-leaf book has been assembled by Tinnerman Products, Inc., to facilitate correct application of these products to specific tasks in aircraft assembly. Sketches are provided on typical locations for the use of speed nuts and speed clips, together with charted engineering standards data.

The text explains the working principle of the spring tension fastener and tabulates the results of comparative vibration tests made between the speed nut and two other types of lock nut.

The sketches provide details on applications of the fastening system in actual use, indicating the specific task to which it is put and the manner in which it is applied. Rubber strip-sealing attachments, scupper attachments, fire walls and stiffeners are typical uses of the individual speed nut applications, while U type fasteners are used for special work in flat attachment and blind fastening. Other types of fasteners for specific attachment are also illustrated. *Tinnerman Products, Inc.*

British Bombing Attacks

The Air Offensive Against Germany. Details of the British air offensive against Germany are summarized in a thirty-page booklet. The inside covers consist of color maps showing the many industrial targets which have been bombed by the R.A.F., and the approximate number of bombing raids against each. Small key figures by each city give the reasons for its military importance, such as munitions plants, oil plants or bases, rail centers, docks, naval bases, etc. The effect of continuous bombing on the German war industries is discussed in the opening pages with the remainder of the booklet devoted to aerial photographs of bombing raids, and a detailed listing of raids by date, target, and observed effect. *British Library of Information.*

Modern Plant Layout

Directional Flow Production. A description of North American's new plant at Dallas and of the special design characteristics incorporated to adapt the layout to the most efficient possible directional flow of production. *The North American Skyline*, July.

Extinguishing Magnesium Fires

A folder on Pyrene G-1 fire extinguishing powder for extinguishing magnesium fires and incendiary bombs. The powder has a graphite base with chemicals which form a blanketing vapor at high temperatures. *Pyrene Manufacturing Company.*

Tension Indicator

A catalogue-sheet giving details and specifications of the Martin-Decker airplane type tension indicator. Principal use is for measuring tension of control cables. *The Martin-Decker Corporation.*

Bomber Flight

Mass Flight to Hawaii. Lieut. Gen. Delos C. Emmons. A description of the largest mass flight to Hawaii ever made by Flying Fortress bombers. The airplanes, each carrying two navigators, were flown independently for routine training purposes from San Francisco to Hawaii, covering the 2,400 miles in 14 hours. General Emmons, who accompanied the flight, expressed satisfaction over the efficient precision with which the flight was carried out. *The Sperryscope*, July.

Summary of Defense Effort

Defense—One Year, issued by the *Office for Emergency Management*, reviews the progress made in defense production, training and organization over the past year. Problems of construction and expansion, raw materials, manpower, housing, war production, subcontracting, and future objectives are outlined. U.S. Government Printing Office.

Anti-Tank Aircraft

Tanks in the Sky. Discussion of the possible use of the Bell Airacobra as an anti-tank weapon. Armed with a 37 mm. cannon in the nose its increased fire power and gun range make it a valuable weapon of attack on mechanized ground forces. *The Bellringer*, August.

Instruction Blueprints

Printed replicas of blueprint wall-charts for purposes of class instruction or shop reference will be of interest to instructors in Machine tool operation and to many new operators in training on defense work. The sheets, measuring 17×21 in. and printed on heavy paper, contain large scale drawings and brief descriptive data on different subjects. Three sample sheets received by the Aeronautical Review are titled *Thread Forms and Formulas, 60° V-Type Thread Dimensions*, which gives sizes of tap drill and clearance drill, and *Lathe Cutting Tools. Atlas Press Company.*

Engineering Art

Artist-engineers of Douglas Aircraft are helping to speed up production by the creation of three-dimensional drawings, or production illustrations as they are called. These cutaway drawings reduce the time necessary for instruction and supervision by showing in a simple, easily-understood manner the details of aircraft construction and assembly. Originator of the production illustrations department at Douglas is George Tharatt, who used such diagrams during the first World War when he was an R.A.F. technical officer. Various types of production illustrations are shown. *Douglas Airview*, June.

From the Industry

Civil Aeronautics Administration

According to C.A.A. figures released July 1, there are now twice as many civil airplane pilots in the U.S. as there were last year. In one year, the number of certified airplane pilots has increased by 100.6 per cent and licensed airplanes have increased 58.7 per cent.

There were 82,277 pilots on July 1, 1941, as compared with 41,006 a year ago. This great increase is mostly due to the pilot-training program of the C.A.A. which is continuing its "mass production of pilots" with a class of 12,000 now studying in the summer session of its 1942 program. During the year, this program will produce about 37,000 more civilian pilots.

The 22,025 certificated airplanes, exclusive of military craft, listed on July 1, 1941, showed a great increase over 1940's figure of 13,878. This increase is also due largely to the pilot-training program in which many airplanes were bought for use in training and by new pilots for their own pleasure or for business flying.

A plea for action on the part of the states toward the elimination of public utility telephone, telegraph and power transmission lines constituting dangerous hazards to airport approaches was made recently by Oswald Ryan, one of the five members of the United States Civil Aeronautics Board. Mr. Ryan spoke to the National Association of Railroad and Utility Commissioners meeting at St. Paul.

Mr. Ryan said in part: "Public utility wires bordering airports constitute one of the great hazards to air transportation in the United States. During 1939 and 1940 there were 105 air accidents due to collision of non-scheduled aircraft with these obstructions to airport approaches. Safety is a relative thing but no airport with such obstructions can be called a safe airport. Certainly no pilot knowingly flies into a telephone or power transmission line. It is true that frequently faulty technique or bad judgment on the part of the pilot contributes to the accident, but the fact remains that the dangerous barriers were there and that if they had not been there would have been no accident.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Review.

"Public safety requires the elimination of these public utility obstructions to the Federal airways and the public utility regulatory commissions of the states have an opportunity to make a valuable contribution in this respect. Those commissions which are empowered by existing laws to issue orders requiring the elimination of unsafe public utility facilities have the necessary authority to deal with this problem. The commission, after notice and hearing, can require the removal of the obstruction and allow the utility to recover the cost through the rates paid by the consumer of its service. That is a reasonable and just charge against the utility consuming public. Where the state utility commission does not possess the necessary authority to accomplish this result, it should be given such authority."

Seventy-five new airports have been approved for the nation's system of defense and civil landing fields since January 1 as compared with 51 added during the entire year 1940, according to announcement by Brig. Gen. Donald H. Connolly, Civil Aeronautics Administrator. This brings to 2,277 the total number of C.A.A. approved airports throughout the continental U.S.

Thirty-six new seaplane bases have been made available since January 1. These bases are for flying boats and seaplanes and have been installed under a joint program of the C.A.A. and the National Youth Administration. They are located along all the coasts and inland around the shores of the lakes and along rivers suitable for plane landing. Including the bases and anchorages of the Army, Navy, Coast Guard and Marine Corps, there were 325 the first of the year. Now there are 361, and of these 20 are equipped for night use.

Administrator Connolly reports that the Army and Navy are relying to an increasing degree on the C.A.A. pilot training courses to supply flying cadets for their air arms, as indicated by analyses for June showing that 39 per cent of all cadets joining the Naval Air Reserve and 29 per cent of those entering the Army Air Corps are C.A.A. pilot trainees.

Army and Navy records indicate that the ratio of C.A.A. trainees among Naval enlistments was 44 per cent greater during June than during the three months preceding and among Air Corps enlistments was 26 per cent greater. The larger Navy increase is attributed to the fact that the Navy gives C.A.A. advanced students credit for 43 hours of flying, whereas the Army does not.

A detailed statement recently issued by the C.A.A. explains the Civil Air Regulations recently adopted to stratify the air and establish new procedures for civil fliers making contact flights on the civil airways at altitudes of more than 3,500 ft.

Contact flight rules for civil airways above that altitude require all airplanes to be equipped with two-way radio and that the pilot must hold the F.C.C. restricted telephone permit. The radio equipment must meet specified standards and the airplane must be equipped with a sensitive altimeter, compensated for changes of temperature, and capable of being adjusted for changes in barometric pressure.

If flying inside a traffic control area or about to enter such area, the private flier must file a flight plan with the nearest airway traffic control station. On civil airways outside of traffic control areas, at more than 3,500 ft. altitude, the private pilot is required to adopt another airline practice and fly at odd or even thousand-foot levels measured from sea level depending on the proper altitude for the airway and the direction being flown.

A pilot is required to keep in touch with the nearest airway or airport radio station in the same manner as required for instrument flights and to give position report when passing over designated radio fixes, make of airplane, license number, altitude and next station to which he will report. Before entering a control zone of intersection, the pilot is required to give the same information in addition to the time he expects to be over the center of the zone.

Flights below altitudes of 3,500 ft. over either ground or water and flights above 3,500 ft. not made on civil airways are not affected by these air stratification regulations.

U. S. Army

The War Department has announced that, in an effort to solve the problem of a "flying observation post" to observe artillery fire, lines and progress of attack and disposition of troops, the Army is procuring thirteen autogiros of new design to organize a test squadron for further experimentation. The field artillery in cooperation with other interested ground forces—infantry, cavalry and the armed force—will test the new aircraft in maneuvers as soon as the squadron is formed.

The autogiros selected are to have a pusher propeller, the jump take-off feature and practically vertical descent in landing. The engineering mock-up of the cockpit is reported to be of radical design from an observer's viewpoint and it is said that the autogiro is well adapted for field artillery work. Further tests are to be carried on with the new squadron.

The autogiro, as an "air O. P.," will be tested under conditions simulating actual service in the field. The craft will be capable of landing in confined areas and on rough terrain. Once in the air, it would be a highly elevated observation post. Communication would be handled by two-way radio or by landing for consultation. The craft would be employed in low-flying missions over territory in the hands of friendly troops. Enemy fighting ships cruising at low speed would run head-on into ground fire, or be attacked by our own fighters. Flights will be of short duration, for the most part. The craft will take off, observe an adjustment and land again. Enemy aircraft will have to be in the immediate vicinity to challenge the autogiros.

The rapid growth of the U.S. Army Air Corps has made it necessary to reassign National Guard pilots to newly formed Regular Army units in order to utilize their experience in balancing organizations comprised mostly of young pilots just out of flying schools, according to War Department releases.

Only pilots, engineering officers and supply officers are being transferred. In order to maintain National Guard Air Corps Units at their prescribed minimum of 15 pilots, officers being reassigned must first be replaced by graduates of training center air schools. Regulations also call for at least two experienced pilots in each of the 22 observation squadrons comprising the National Guard.

The Air Corps of the Regular Army is drawing upon approximately 400 pilots in the National Guard. The experience these officers have obtained through an average of from seven to eight years will be helpful to young pilots, providing them a stable background that can only be achieved from experience.

Paris, Tennessee, has been selected as the site for a new Barrage Balloon Training Center, the War Department has announced. Construction will commence as soon as plans can be made and contracts awarded. The new Tennessee camp on 1,000 acres of land, 7 miles southeast of Paris is expected to have facilities for 7,000 men.

Training with the hydrogen-filled sausage bags is now under way at the temporary Barrage Balloon Center at Camp Davis, North Carolina. Instruction at the school will be given to 160 officers and 750 enlisted men, attending six- and twelve-weeks' courses. The first group of students was selected from approximately 2,200 soldiers who have been conducting tests with Barrage Balloons at Camp Davis. Colonel Robert Arthur, Coast Artillery Corps, is in command of the school.

Army students who complete the first course at Camp Davis will be used to train other officers and enlisted men, and assist in the formation of any new units authorized by the War Department. Knowledge gained by the British in the use of the captive bags anchored over England is used by U.S. Army instructors. For Army training, a barrage balloon 35 feet in diameter and 87 feet in length is used. The outer covering is of cotton fabric, impregnated with synthetic rubber. Experiments have shown that the synthetic product holds hydrogen gas better than the natural rubber.

Two types of barrage balloons are generally under experimentation—one called ballonet, and the other dilatable. In the ballonet type the lower portion of the balloon is an air chamber separated from the gas chamber. A wind scoop takes air into the air chamber, causing an internal pressure proportional to the wind velocity. In the dilatable type,rubber shock absorber cords permit the balloon to expand or contract as pressure is changed.

Aeronautical Chamber of Commerce of America

Releases of the Aviation News Committee report that through farsighted plant expansion and the training of several thousand new workers, production of airplane propellers has reached a point which seems to preclude any potential bottleneck in the nation's aerial defense program.

Manufacture of propellers, the Committee pointed out, is one of the most highly skilled operations in the entire aeronautical industry. In most instances, the propeller is specifically designed for the particular airplane-engine combination it is intended to complement. Because certain key processes must be done by hand, months are often required for the training of propeller workers.

Scientific research has advanced the 1941 propeller, with its two, three and four metal blades, far beyond those of World War I, which, being carved from several layers of wood and then glued together, were extremely vulnerable to machine gun bullets, hail storms or even flying stones on a runway.

With production still well below peak, two large producers of propellers are reportedly putting out 2,500 to 3,000 propellors each month.

National Aeronautics Association

N.A.A. reports indicate that plans for the Civil Air Defense Services to enroll private airplanes and pilots in the interests of civilian defense are under study by the Army. The Army's interest, aside from the traffic problem which is being taken care of by the new Civil Air Regulations, is to prevent sabotage and espionage which might result from unrestricted use of private airplanes. If all private airplanes, owners and pilots are registered, it will be possible to get an absolute check on the comparatively few aliens and persons of doubtful character who now hold licenses. By this means, the private flying fraternity can police its own ranks and continue to fly without undue restriction.

The first essential in setting up the CADS under national coordination is the approval of the simpler phases of the plan, including registration and the formation of a wing in each state to establish a chain of command. Training regulations and directives for home defense duties can then go forward. Step by step, activities can be extended to include youth training and model building so that young people can prepare themselves to enter the program when reaching flying age.

Meanwhile plans for the organization

of state wings and local squadrons continue to advance. Correspondence received by N.A.A. headquarters from many states indicates that groups already formed, and many responsible leaders ready to organize in their localities, are anxious to tie in with a national plan so that their work can be of maximum effectiveness for defense.

National Aviation Training Association

The air arm has been recognized as such an important division of national defense that special consideration on draft deferment requests has been ordered for students, instructors and workers in aviation, according to N.A.T.A. releases. Brig. Gen. Lewis B. Hershey, deputy director of the selective service system, has instructed that all local draft boards "give serious consideration" to the deferment of men receiving instruction in accredited flying schools, students in college aeronautical engineering, airplane design and kindred courses, as well as instructors in those divisions.

Referring to workers in aircraft plants, General Hershey's order said that shortages exist in practically all types of occupation; the demand for such men is far greater than the current supply, and if they are inducted into the army, the demand will not be met. The general's order specifically mentions trainees in the Civilian Pilot Training Program as subject to deferment consideration, until such time as they have finished their courses. CPT trainees are under pledge to enroll for Air Corps service in case they demonstrate, in their flight lessons, that they are specially fitted for military training.

The Austin Company

Releases from The Austin Company, which designed and built the new Bell Aircraft assembly plant at Niagara Falls Airport, describe the structure's characteristics especially planned to expedite application of Bell's new concept of mass aircraft production.

With all preliminary fabrication still centered at the Bell plant in Buffalo, parts are delivered to the new assembly plant by truck. Parts bins are transferred directly from the truck to sub-assembly stock cribs alongside each department, or direct to the final assembly station where they are to be used.

Four main assembly lines side by side extend from east to west through the center of the plant in a high bay with 30-ft. clearance below roof trusses. Most sub-assembly work has been concentrated in four lower 50-ft. monitor bays. Front and rear fuselages are completed in the two bays on the south, and wing sections and cabins are built on the north side. Cranes and monorails facilitate the movement of parts and sub-assemblies in each department, where spray booths designed to the specific requirements of each unit are located to eliminate unnecessary handling.

Each complete sub-assembly reaches the final assembly floor already painted on its own specially designed dolly, right at the point where it is to be installed. At 14 stations along each of the final assembly lines the various components are ultimately delivered to their respective stations from sub-assembly departments by overhead conveyor.

A network of underfloor service ducts carries 110-volt and high-cycle power facilities and compressed air to more than 300 outlet boxes across the entire plant. These are spaced on 25-ft. centers throughout the major portion of the plant and 15 ft. apart along each of the four final assembly lines. Additional outlets are also provided on the columns and at certain overhead points.

Generous areas of sash in side walls, monitors and skylights above the center bays provide an excellent distribution of daylight, which has been controlled by the use of Aklo glass on the south and west. This illumination is matched at night by the most modern fluorescent lighting facilities, which reach maximum efficiency in an interior where walls and structural steel are all painted white.

A new type of rectified fluorescent (R.F.) luminaire, specially developed by General Electric Company for the illumination of high bays, and used here for the first time, has been installed at 720 positions down the center of the plant, where two assembly aisles open into an unobstructed area of 200 sq.ft. at the airport end. The two-lamp units installed here on 12-ft. centers, 30 ft. above the production floor, are designed to yield a minimum of 30 foot-candles illumination on the working plane in continuous service. A special circuit provided in these luminaires rectifies a.c. current so that d.c. current passes through the tubes themselves. This has the effect of smoothing out the current wave and eliminates stroboscopic effect without any special balancing.

Comparable lighting intensity is provided for sub-assembly work in the two 50-ft. bays on either side of the final assembly area. There, two-tube Hygrade Sylvania Mazda fluorescent units are mounted end-to-end, 2 ft. apart, so that the tubes parallel the production line in rows 16 ft. apart. In bays on the south where provision has been made for future construction of a mezzanine, these units are mounted at a height of 19 ft. 6 in. On the north the units are mounted at a height of 12 ft. $5\frac{1}{2}$ in.

Carrier Corporation

Recent Carrier Corporation releases state that the problem of intense heat and humidity in airport control towers has been solved by air conditioning engineers in the new Washington National Airport. Nerve center of the airport as far as airplane traffic is concerned, the control tower has presented a particular problem for the air conditioning engineer because of its glass-enclosed walls and necessarily exposed position to direct rays of the sun. They are usually located atop administration buildings at airports. In mid-summer, heat and humidity in most control towers become almost unbearable. Direct rays of the sun, beating down on the glass sides, make the interior a veritable "hot-box."

Radical ideas in airport tower design were incorporated in the plans finally evolved. Upper and lower halves of the tower's glass walls are set outward at an angle of about 90° to each other. This setting avoids all reflection of ground lights, airplane lights, sun, moon and stars. Each section is fitted with a window wiper operated from inside hydraulically by means of an oil compressor. Heat-absorbing glass, which excludes heat of the sun and retains inner heat, was used. It has a green tinge, preventing glare and reflecting sunburning actinic rays. Sunburn has been a bane to most of the nation's control tower operators. Two Carrier centrifugal machines each of 210-ton cooling capacity supply refrigeration for the air conditioning system which keeps the interior of the control tower cool and comfortable.

Consolidated Aircraft Corporation

In response to a request from Sidney Hillman, associate director of the Office of Production Management in Washington, D. C., Major R. H. Fleet, president of Consolidated Aircraft Corporation, has announced that the San Diego company would start a program to train and emply women in aircraft manufacture. Mr. Hillman had communicated with 200 airplane companies asking them to consider training and using women in aircraft work. He asked that wage-and-hour standards not be lowered where women are employed.

At Consolidated, where more than 19,000 men are now engaged in the construction of twin-motored and four-motored land and sea bombers for the United States, Great Britain, Canada, the Netherlands and Australia, women will be trained in the lighter mechanical operations.

According to Major Fleet, this possible move had been planned for some

time, and now through the expansion of the aircraft industry the demands upon man-power have become so much greater that Consolidated is looking ahead to plan for any possible emergency which might hazard the production of the all-necessary bombers. Preference is to be given to women who are wives or relatives of men already employed at Consolidated. This will prevent, or tend to prevent, any untoward migration of women from other portions of the country. The women to be employed will be given a thorough background in what they will be expected to do. This work will include light mechanical operations, machine and precision assembly work.

The company will start with 300 or 400 women and increase the number as necessity demands. The women will be quartered on the mezzanine floor of one of the assembly buildings. They will be trained by instructors who have had thorough experience in Consolidated operations.

The B. F. Goodrich Co.

The development of a bullet-sealing hose that eliminates an "Achilles heel" in the armor of America's combat airplanes by protecting essential fuel systems from punctures, has been announced by The B. F. Goodrich Company, Akron, Ohio. An outgrowth of the development of self-sealing fuel tanks, the new-type hose not only protects fuel systems from bullet punctures but also makes possible substantial weight savings in the average bomber. Weight saving is important because it provides added fuel capacity to widen the bomber's flight range. The bullet-sealing hose eliminates the weight of auxiliary metal fuel systems which were needed to guard against the hazard of punctures to main fuel lines.

Secret of the hose's construction is an unusually effective sealing member that prevents fuel leaks even under 10 to 15 pounds pressure and despite numerous punctures from high caliber machine gun bullets. The hose has a total wall thickness of less than $^{5}/_{16}$ in. and is available in diameters ranging from a half to three inches. Principal use of the hose is to connect fuel tank cells and engine supercharger systems.

The inner surface of the hose is a layer of Ameripol, the B. F. Goodrich synthetic rubber which is highly resistant to oil and gasoline.

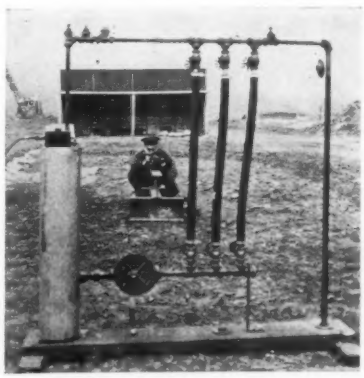
Northrop Aircraft, Inc.

Announcements by Northrop Aircraft, Inc., indicate that the company has "borrowed" eight research engineers from Vultee Aircraft, Inc., to speed Northrop production for U.S. defenses in the air. Northrop designs for the U.S. Army Air Corps needed additional specialized engineers to step up the completion schedule.

Early this year, Northrop and Vultee combined their productive resources to produce the Vultee designed Vengence dive-bomber in mass quantity for the British R.A.F. Since then, other competing companies have similarly joined forces in producing complete airplanes of the same design.

Piper Aircraft Corp.

According to Piper Aircraft releases, the use of light airplanes, the same kind that one sees at any airport in the country, was further demonstrated during the Third Army maneuvers being held recently in the desert country north of El Paso. The airplanes,



A marksman using a 50-calibre machine gun tests sections of the bullet-sealing fuel hose developed by The B. F. Goodrich Company to protect the fuel systems of military aircraft.

which were donated along with their commercial pilots, by the leading manufacturers of small sport craft, had just completed successful demonstration tests with the Second Army maneuvers held in Tennessee.

A total of 14 light 65 hp. airplanes made up the fleet used during the cavalry maneuvers and included 10 Piper Cub Trainers, 2 Aeronca Trainers, and 2 Taylorcraft Trainers. All are of approximately the same type with tandem seating allowing excellent visibility in all quarters for the pilot as well as the observer. Two-way radios installed in each aircraft made possible constant communication with the ground units.

Whereas in Tennessee the main tests were conducted in connection with direction of artillery fire, the planes used during the El Paso maneuvers were put to even wider use and received the enthusiastic approval of General Innis P. Swift, in charge of the maneuvers. After an appraisal of the first phase of the maneuvers, Gen. Swift expressed approval of the light ships, calling them the best type of message-carrying equipment the Army has ever had. The General dubbed the fleet of light ships the "Grasshopper Squadron." In emphasizing his satisfaction with these planes, he recounted having radioed for one of these ships which arrived on the spot in 20 minutes. Thirty minutes after arrival of the Cub, he received a radio message from Biggs field, Army headquarters, stating that the plane was on its way.

In modern cavalry tactics, units are usually widely scattered and extremely mobile since the introduction of motorization to speed the work of the cavalry. Under such conditions, the necessity for liaison between units has become increasingly important. While radio has been adopted extensively to link all outlying squadrons, the channels are badly clogged and important messages, many of which need personal attention, can be handled more quickly by airplane in most cases than by radio.

Despite the rough terrain and extremely high altitudes, the light craft demonstrated their ability to land and take off anywhere needed. Most of the desert country is covered by grassy sand dunes which required landings on rutted roads. Since the landing gear tread of these airplanes is the same as that of an automobile, such landings were not difficult. Where no possible natural landing areas existed near headquarters, the Engineer Corps found it could clear a landing strip in a matter of minutes.

Often it was necessary to relay information and maps showing latest enemy positions to units on the go. In such cases, light airplanes would drop their messages in special Air Corps message bags with a long yellow streamer attached. An example of their extreme accuracy came when one light airplane pilot made a direct hit on a scout car in motion, close enough so that the crew caught the message in their hands.

After successful early experiments with the light craft Gen. Swift assigned one to each of nine units for the duration of the maneuvers. While originally only one was assigned to the First Cavalry Division headquarters, it was found that they needed at least five all the time to carry messages to outlying posts and to keep up general reconnaissance. Poor roads winding through the hills made ground liaison almost impractical and the airplanes delivered in 15 minutes messages which would require several hours by car.

Tactical units used the light airplanes for actual reconnaissance. By flying low and dodging around enemy positions, they proved themselves to be almost immune to enemy gun fire from the ground and beyond the danger of enemy air action. The two-way radio enabled

commanding officers to know immediately the exact enemy positions and best possible routes for advance. During many of these reconnaissance missions, the Commander himself flew along and thus obtained a clear picture of the existing situation. In one case, various units of one command advanced to new positions during the night and failed, or were unable, to report their exact position the next morning. The commanding officer took off in a "Grasshopper," located each unit easily and quickly, and landed by each group for personal explanation of the day's activities. One Major, reporting his reaction to the "Grasshoppers," wrote that he did two hours of reconnaissance work in ten minutes.

The present maneuvers represented, without a doubt, the most gruelling test under which the light airplanes could be put. Most of the landings and take-offs were made at elevations of more than 5,000 ft. which reduces performance considerably. In practically every case, the craft were flying overloaded with heavy radio equipment, fully armed men, maps, and other paraphernalia. They were also operating in extreme heat which also reduces lift. High winds and many severe thunder storms did not hamper the usefulness of the craft.

The satisfactory performance and utility of the small airplanes in these adverse conditions indicate that speedy adoption of "Grasshoppers" for the Army may be expected. The light planes will be put under further tests during the maneuvers in Louisiana which are to be the largest peace time warfare ever conducted by the United States Army.

Pyrene Manufacturing Company

The national emergency has produced an extinguishing agent that puts out magnesium fires in industry and in incendiary bombs. This new substance, known as Pyrene G-1 Fire Extinguishing Powder, is the result of combined research by the Dow Chemical Company, Midland, Mich., manufacturer of magnesium alloys, and the Pyrene Manufacturing Company, Newark, N. J., fire protection engineers and extinguisher manufacturers who recently announced the development.

In addition to incendiary bombs, the use of magnesium alloys has skyrocketed in aircraft and other defense production. Production against metallic fires, therefore, is a national necessity. Usual extinguishing methods, however, do not work. Makeshift substances such as talc, soapstone and sand are unsatisfactory. Water or any substance containing moisture increases the speed of combustion, sometimes with explosive violence.

The new product, Pyrene G-1 Fire Extinguishing Powder, is a dry inert compound that stops the combustion of magnesium as well as other metals such as sodium, potassium, aluminum and zinc. It also contains a material which, when heated, forms a heavy, air-excluding, fire-smothering vapor. The powder is applied to the fire by spreading it with a scoop or shovel. Being non-abrasive, it may be used freely around machinery.

The *National Fire Protection Association Quarterly* for April 1941 points out that "the usual extinguishing agents have no extinguishing effect on burning magnesium alloys, and the best extinguisher for this type of fire is a special powder manufactured by Pyrene Manufacturing Company." It is emphasized, however, that proper types of approved fire extinguishers are needed to put out secondary blazes in nearby combustible materials ignited by the metallic fire.

Solar Aircraft Company

Solar Aircraft Company, San Diego, Calif., has enlisted the cooperation of the Edward G. Budd Manufacturing Company of Philadelphia to aid in the production of exhaust manifolds and cowling for military aircraft, Edmund T. Price, President of Solar Aircraft Company, has announced. Exhaust manifolds, made primarily from stainless steel, have been the principal product of the aircraft concern for over ten years, during which time the company has manufactured and sold over 20,000 units.

The Edward G. Budd Manufacturing Company has pioneered many developments fabricated in stainless steel, including streamlined railroad passenger cars, truck trailers, marine structures of various types, as well as many airplane parts. Budd's patented "shotweld" system is in general use throughout industry, and Solar Aircraft Company has been a licensee of the Budd patent for a number of years. Under the joint agreement between the two companies, immediate production of the increased number of aircraft parts demanded by the military services will be possible. Production has already started in the Philadelphia plant.

Roxalin Flexible Lacquer Co., Inc.

The Civil Aeronautics has just given its approval to a new protective coating for fabric-covered airplanes, according to announcements by Roxalin Flexible Lacquer Co., Inc., manufacturers of the product, which is called Emycel. It is said to be capable of stepping up finishing production as much as 50 per cent, reducing fire hazard by 64 per cent and giving positive protection against fabric mildew and rot.

Because the civilian or light airplane industry of today is in much the same position as the automotive industry of 1924 in that the finishing operations are the bottleneck of production, it is said, Emycel removes one of the great obstacles to the inevitable arrival of mass production of light aircraft. By reducing the number of coats required from as many as fourteen, some of them laboriously hand-brushed, to a maximum of four sprayed coats, Emycel is able to save at least 50 per cent of the man-hours formerly required and makes it possible for the finishing department to keep pace with other assembly operations that are already on a straight line production basis.

In addition to increasing light airplane production, scientific tests are said to prove that Emycel burns 64 per cent slower than the contentional dope used on light aircraft. Its slow burning rate makes it possible to blow out burn-fabrics by slipping or diving the ship.

It is reported that 80 per cent of most fabric failures are attributable to fabric rot and weathering, caused by mildew producing organisms in the presence of moisture which penetrates to the inside surface of the fabric. Moisture penetration through the conventional fabric dopes was caused by loss of flexibility and poor penetration at the time the coating was applied. It is said that since Emycel provides complete penetration of the fabric and retains permanent flexibility, mildew and rot can be effectively controlled.

Whiting Corporation

H. W. Anderson, Manager of the aviation department of Whiting Corporation, Harvey, Illinois, has announced a new simplified dolly for handling propellers.

The unit, one of an extensive new line of "matched" equipment, handles two propellers; it is heavily constructed but streamlined to permit easy access to the work. Heavy rubber tires provide smooth shock absorbing operation. The new dolly has been thoroughly service-tested and is available in various sizes for all makes of propellers.

Republic Aviation Corporation

Telephone communication on the assembly line—between men working inside the fuselages and those on the outside—is now used to speed production of Republic P-43 "Lancers" at the Republic Aviation Corporation plant, according to recent Republic releases. Better teamwork for production crews and time-saving features in making contact

(*Continued on page 55*)

Engine Supercharging

A bibliography giving references for research in this specialized field. Revised and brought up-to-date from the fifty volume Bibliography of Aeronautics compiled and published with the cooperation of the Work Projects Administration from the Aeronautical Index of the I.Ae.S.

The flight range of today's airplane includes any altitude as high as the stratosphere. This is made possible through the development of the airplane engine supercharger which permits the engine to operate normally at high altitudes.

For many years experimenters have been working on mechanical devices for supplying the internal combustion engine with a greater weight and volume of charge than would normally be induced at the prevailing pressure and temperature. Supercharging is an old idea and was suggested and tried out even before it was applied to the automobile as a means of obtaining as much power as possible. In 1859, a commercial compressor was developed and manufactured by the P. H. and P. M. Roots Company of Connersville, Indiana. The Roots blower, a displacement type supercharger which has been used on airplane engines, probably received its name from this company.

Development in Europe

The military use of the airplane in the World War of 1914–1918 resulted in considerable research being undertaken in Europe to compensate for the loss of engine power output with increase in altitude. During 1915–1916 experimental work was started on the exhaust driven turbo supercharger by the Royal Aircraft Establishment at Farnborough, England, and in France, by Auguste Rateau in conjunction with the Farman Company. In 1917, the first Rateau supercharger was applied on a 175 hp. engine and maintained the ground pressure up to an altitude of about 18,000 feet.

The engineers in Germany and Switzerland were also carrying on experimental work on superchargers but devoted their attention to the gear-driven superchargers of the multi-stage type. The exhaust-driven type of supercharger was not investigated in Germany, although a patent for a turbo supercharger for a four cycle engine at sea level was issued to Schmidt in 1911. In 1916, Noack, a German engineer, turned over to his government drawings of a supercharger for experimental construction by the Brown-Boveri Works at Mannheim. Otto Schwade of Erfurt, manufacturer of the Stahlherz rotary engine, also became interested in the problem and took out patents covering the design of superchargers. Later the Allgemeine Elektrizitaets-Gesellschaft (A.E.G.) and the Siemens-Schuckert concerns investigated the problem. The superchargers designed by these companies were driven by the engine itself or, in the case of large multi-engine airplanes, by a special engine installed for that purpose. Experimental airplanes with supercharged engines were produced, including a German multi-engine airplane with a separate 120 hp. engine to drive the supercharger but, at the time of the Armistice, the experimental investigation on these installations was not sufficiently advanced to warrant production in quantities.

Development in the United States

In 1917, shortly after the United States declared war on Germany, the Government requested Dr. Sanford A. Moss, of the General Electric Company, and E. H. Sherbondy, consultant engineer, to take up the development of the supercharger in this country. This request was made at the suggestion of Dr. W. F. Durand, then chairman of the National Advisory Committee for Aeronautics, because of the experimental work done by General Electric since 1903 on gas turbines and centrifugal compressors. Both men started work on the turbo-driven supercharger, although E. H. Sherbondy made some experiments with a compressor gear driven from the engine shaft but eventually abandoned this method for the turbo drive.

Dr. Moss, who is credited with the development of the turbo supercharger, rushed the construction of his apparatus and applied it to an airplane engine at sea level. Tests were first made on the supercharger alone at the Lynn plant of General Electric, but additional tests were later made on a Liberty engine mounted on a dynamometer at McCook Field, Dayton, Ohio. After a period of development at sea-level pressure, it was decided that nothing further could be accomplished unless tests were made under full speed at altitude. Therefore the equipment was shipped to Pike's Peak. During September and October of 1918 tests were run on the supercharger at an altitude of 14,109 feet. The equipment was mounted on a cradle dynamometer and measurements were made of the power output, gasoline consumption, etc. At this altitude the Liberty engine, without the use of a supercharger, developed only 230 hp. of its rated 350 hp. Minor adjustments and refinements were made on the supercharger until the engine developed 356 hp. at this altitude.

It was then felt that the supercharger was sufficiently developed to warrant an airplane test flight, and arrangements were being made for the installation of the supercharged Liberty engine on an airplane when the Armistice was signed. Shortly after the war, army officials studied the results obtained in tests on Pike's Peak and, as a result, the equipment was finally installed on an airplane. In the early part of 1919, after a number of tests on the ground, a successful flight test was made. All the early flight tests were made by Major R. W. Schroeder with Lt. George W. Elsey as flight observer. In the beginning, altitude records were broken on almost every flight and on October 4, 1919, an altitude of 32,335 feet was attained. It is interesting to note that the two-passenger Le Pere airplane on which the equipment was installed had a ceiling of approximately 20,000 feet. Its speed at this altitude was 70 m.p.h. With the use of the supercharger, this speed was increased to about 140 m.p.h. at an altitude of 22,000 feet.

After the early flight tests were completed, the Army Air Corps devoted its attention to the development and perfection of the turbo supercharger. The first "side type" turbo supercharger, in which the turbine wheel was overhung and exposed to the slip stream for cooling, was designed by E. T. Jones, then Assistant Chief of the Power Plant Section. This "side type" was the forerunner of all present turbo superchargers and was the basis of the design of the modern turbo supercharger. Mr. Berger, who is now the Civilian Engineer in charge of supercharger development at Wright Field, was largely responsible for the promotion of the turbo supercharger and its mechanical development.

E. H. Sherbondy submitted his supercharger to the Army Air Corps at the same time that the General Electric Company submitted the Moss supercharger. In the original test of the Sherbondy unit, the designer pointed out the difficulties that were to be encountered in testing and made specific recommendations for their correction. Both the Sherbondy and Moss units encountered similar and equal difficulties at low altitude but, as a result of the increase in horsepower obtained with the General Electric supercharger in the Pike's Peak tests, the Air Corps went ahead with the development of the General Electric turbo supercharger and dropped the development of the Sherbondy unit.

In 1922, David Gregg, then Chief of the Supercharger Section at McCook Field, developed the first so-called supercharger induction system on a Curtiss D-12 engine. The system consisted of a geared centrifugal supercharger with the carburetor at the inlet of the supercharger delivering air and gas under pressure directly to the cylinders. This unit was later designed as an integral part of the airplane engine rather than as an accessory. A similar type of direct driven centrifugal supercharger was designed by David Gregg for

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the Dusenberg Corporation and was used in 1924 on the first supercharged car to win the Indianapolis race. The first gear-driven centrifugal supercharger used by the Air Corps was developed at McCook Field by the Supercharger Section. The compressor element was built by the General Electric Company and the gear drive by the Allison Engineering Company of Indianapolis.

An interesting gear-driven supercharger unit was designed and submitted by Mr. Morton of the B. F. Sturtevant Company. The unit was driven by a multi-cylinder oil pump built into the main driving gear. The transmitted torque and, therefore, the speed of the supercharger was varied by regulating the amount of oil supplied to the pump. Although the unit failed on engine tests, it was years ahead of its time and was the forerunner of modern hydraulic drives for superchargers.

Types of Superchargers

Of the many types of superchargers developed as a result of these investigations, only three types have been successfully applied to the airplane. These may be classified as follows: (1) the rotary displacement type; (2) the gear-driven centrifugal type; (3) the turbine-driven centrifugal type.

The N.A.C.A. became interested in the Roots blower, a rotary positive displacement gear-driven supercharger, and devoted considerable attention to its development. This supercharger consisted of two cycloid-shaped rotors mounted on separate shafts. The rotors were driven in opposite directions at engine speed or, in some cases, at a slightly higher speed and rolled in contact with one another. One rotor was driven through timing gears while the other received its drive from the crankshaft. The rotors were constructed of an alloy of aluminum or magnesium and were enclosed in a reenforced casing of cast aluminum alloy. The hubs of the rotors were made of steel and mounted on ball bearings.

It was found that the blower gave a continuous but non-uniform rate of delivery, and a receiver was used to regulate this pulsating discharge. Clearances also had to be accurately maintained to prevent the leakage from becoming an important factor. The blower was built by the Allison Engineering Company and was installed on several military airplanes. It proved reliable for long periods of operation and was used by Lieutenant Soucek in making the world's altitude record in a seaplane. The comparatively long life of this type of supercharger was due to the fact that it had no wearing parts other than the bearings. Its simplicity of construction made its cost reasonable and it had the advantage of operating at a slow speed. In all three types of superchargers used on airplanes, it is necessary to cool the compressed air before it enters the fuel system. The Roots blower requires the least amount of cooling. Despite these advantages, the large size and weight of this supercharger, as compared with the centrifugal types of the same capacity, have prohibited its use on modern airplane engines.

Gear-Driven Centrifugal Supercharger

This type of supercharger is constructed as an integral part of the airplane engine and is used universally in high-power radial engines. It is located between the carburetor and intake manifold and consists of an impeller enclosed in a close fitting housing which has an air intake opening leading into the center of the impeller. The crankcases of modern radial and inline airplane engines are so constructed as to form part of the supercharger casing. The gear ratio of the impeller, which is driven by gearing from the crankshaft, varies from 6:1 to 10:1. Ratios as high as 14:1 have been attempted but difficulties due to excessive mechanical stresses and heating of the mixture were encountered.

The mixture admitted through the opening in the casing strikes the center of the rotating impeller and is thrown outward at a high velocity into diffuser vanes. As the mixture flows through the diffuser, its high velocity is gradually reduced and a high pressure head is built up. The mixture then flows into the distribution chamber from which it is carried to the cylinders.

The impeller, which consists of from 10 to 18 blades, is usually constructed of nickel-chrome steel or duralumin with reenforcing ribs. To withstand the high speeds and engine power developed, this type of supercharger requires careful design and construction. Particular attention must be given to the impeller shaft bearings. When high gear ratios are used, the engine must be operated carefully and high octane fuel is required to prevent detonation. Also, the gear-driven supercharger requires horsepower from the engine for its operation. These disadvantages are offset by the many advantages of the gear-driven supercharger, some of which are as follows: (1) lightness and positive action; (2) improved distribution of mixture to cylinders; (3) the vaporization of the mixture is improved as the fuel breaks up into fine drops as it passes through the system; (4) although the supercharger adds to the weight of the engine, the pounds per horsepower ratio is decreased due to the considerable increase in horsepower produced; (5) a two-speed ratio can be used which combines the high take-off characteristics of a medium supercharged engine and the maximum performance that can be obtained at high altitude by full supercharging; (6) it is very compact for a given capacity.

The direct driven supercharger has also been successfully used in Germany on liquid-cooled engines. This system was developed in 1917 by Brown-Boveri at Mannheim, and a supercharger was constructed which was capable of maintaining normal engine output up to 15,000 feet. The impeller was made of a high tensile steel and rotated at approximately 11,000 r.p.m. In July, 1918, it was tested on an A.E.G. machine and reached an altitude of 20,000 feet. The modern liquid-cooled German engine uses a pressure carburetor with a gear-driven supercharger located on the air inlet side of the carburetor.

Turbine-Driven Centrifugal Supercharger

The construction of this supercharger is similar to that of the gear-driven centrifugal type, the only difference being in the method of drive. The impeller is driven by a turbine wheel mounted on the impeller shaft. The turbine wheel is not enclosed and is always located directly in the atmosphere. The exhaust gases from the engine are conducted through the manifold to buckets located on the circumference of the turbine wheel. The discharge of the exhaust gases through these buckets into the outside atmosphere causes the turbine to rotate at speeds up to about 25,000 r.p.m. A by-pass valve is installed in the exhaust manifold to control the speed of the turbine and the impeller.

The main advantages of this supercharger are as follows: (1) flexibility of control which enables it to maintain ground engine power up to very high altitudes; (2) simplicity of mechanical working parts; (3) no appreciable power from the engine is required to drive the system; (4) a greater boost is given at altitude as the speed of the turbine wheel increases with altitude. Its main disadvantages are the mechanical and material difficulties caused by the centrifugal stresses set up at high speeds. The tendency of the turbine wheel to warp, due to the excessive heat striking the blades, is being eliminated through the use of high chromium and stainless steels.

When superchargers were first developed, they were used to restore ground level power at altitude. Today the supercharger is used not only for increasing altitude output but, also, for increasing take-off power. This requires a highly developed supercharger. It is probable that the continued development of intercoolers and supercharging methods will enable the engine designer to meet future performance demands of the military and high altitude transport airplanes.

ROBERT R. DEXTER

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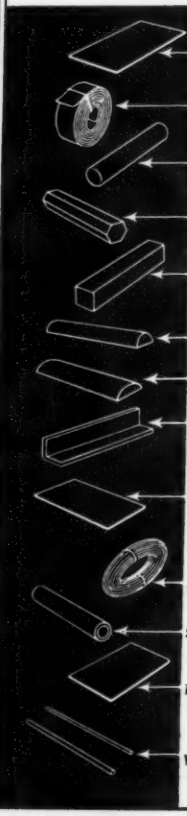

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Rounds Hot Rolled	Diameter—¼" to 8" Random Lengths—6' to 18'	¼" to 4½"	¼" to 3"
Cold Drawn	Diameter—½" to 3"	¼" to 2"	½" to 3" diameter
Hexagons Hot Rolled	⅜" to 2⅛"	⅜" to 2⅛"	⅜" to 2⅛"
Cold Drawn	½" to 2"	.....	½" to 1"
Squares Hot Rolled	$\frac{5}{16}$" to 2¼"	$\frac{5}{16}$" to 2"	$\frac{5}{16}$" to 1"
Cold Drawn	½" to 2⅛"	.....	½" to 1"
Half Rounds Hot Rolled	⅜" to 2"	.....	.....
Half Ovals Hot Rolled	½" to 1½"	.....	.....
Angles Hot Rolled	Leg Dimensions— ⅞" x ⅞" to 3" x 3" Thickness—⅛" to ½"	.....	.....
Flats Hot Rolled	Thickness—⅛" to 2" Width—½" to 10"	⅛" x ½" to 1" x 10"	Thickness—¼" to $\frac{15}{16}$" Width—½" to 2"
Cold Drawn	Thickness—$\frac{31}{64}$" to 2" Width—½" to 4" Random Lengths—6' to 16'	.....	.....
Wire Cold Drawn	.003" to ½"	.003" to ¼"	.003" to ¼"
Seamless Tubing Cold Drawn	Outside Dia. $\frac{1}{16}$" to 5" Wall Thick.—.002" to .284"	$\frac{1}{16}$" OD to 4" Dia. Wall Thick.—.002" to .259"	OD ½" to 3" Wall Thick.—.035" to .259"
Plate Hot Rolled	Thickness—¼" to 2" Width—10" to 160" Length—10" to 480"	Thickness—¼" to 2" Width—10" to 140" Length—200" to 260"	.....
Welding Gas	$\frac{1}{16}$" to $\frac{1}{16}$"	¼" to $\frac{1}{16}$"	$\frac{1}{16}$" to $\frac{1}{16}$" dia.
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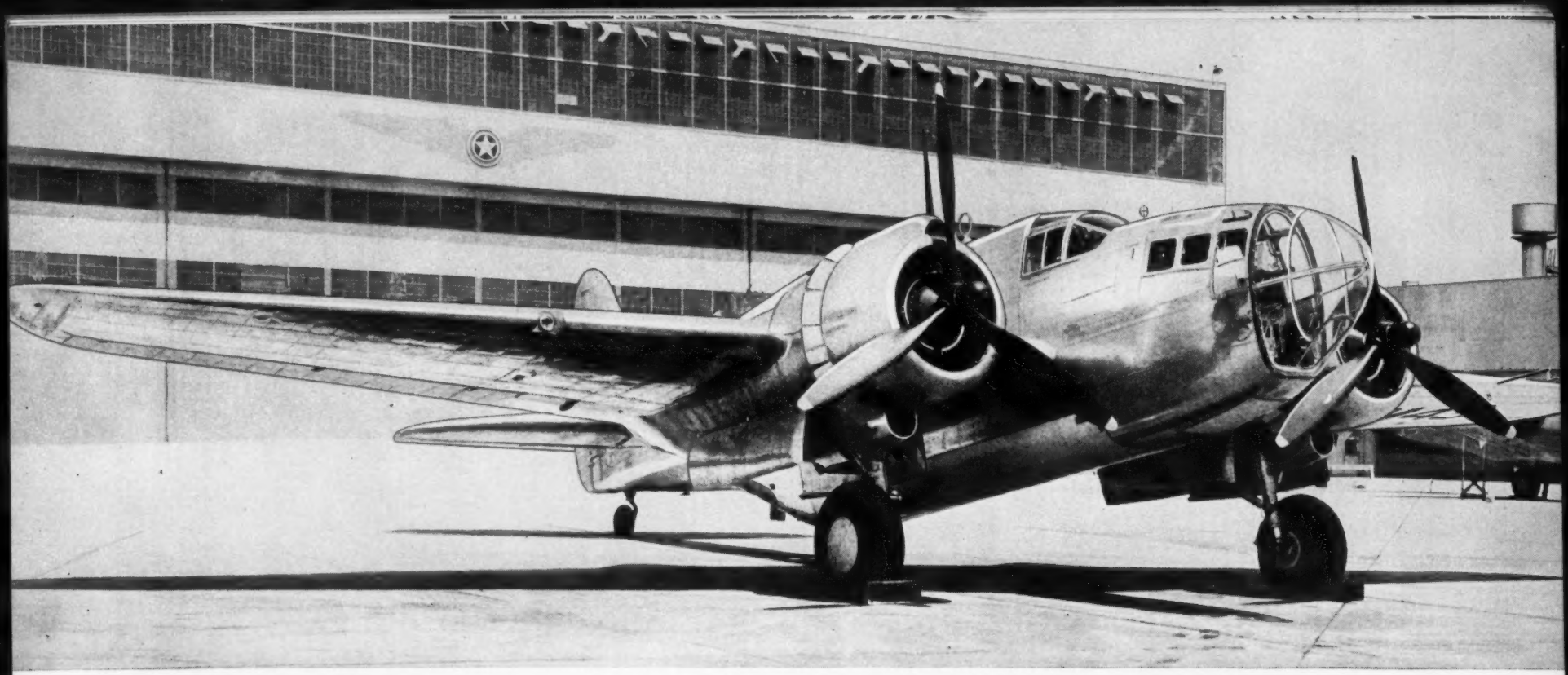

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NEWS REVIEW

(*Continued from page 6*)

announced the establishment of clipper service between California and Hawaii, supplementing the "long haul" service to the Orient.

August 9. Washington news sources revealed the delivery to Russia of American fighter airplanes built for the British but released by them to the U.S.S.R. It was said that defense officials had also virtually completed arrangements to provide Russia with the latest type medium bombers. The method of delivery being used for the fighters was not disclosed, though it was generally assumed that they were either being moved by freighters across the Pacific to Vladivostok, Siberia, or were being flown to Alaska and thence across the Bering Strait to Siberian air bases, as will be the case with bomber deliveries.

August 9. Marine Corps officials stated that Marine parachute jumping as an important phase of the coordinated Army, Navy and Marine invasion maneuvers along the Carolina coast marked the first time parachutes have been used in such maneuvers anywhere in America.

August 9. Survey of aviation gasoline stocks in the U.S. showed that they amounted to 7,673,000 barrels as compared with 5,475,000 a year ago, an increase of about 40 per cent.

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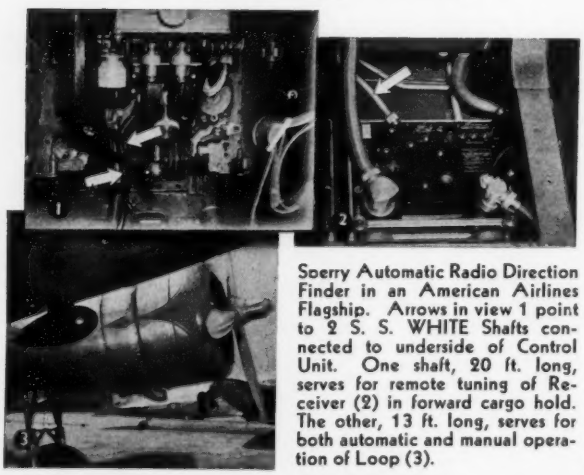

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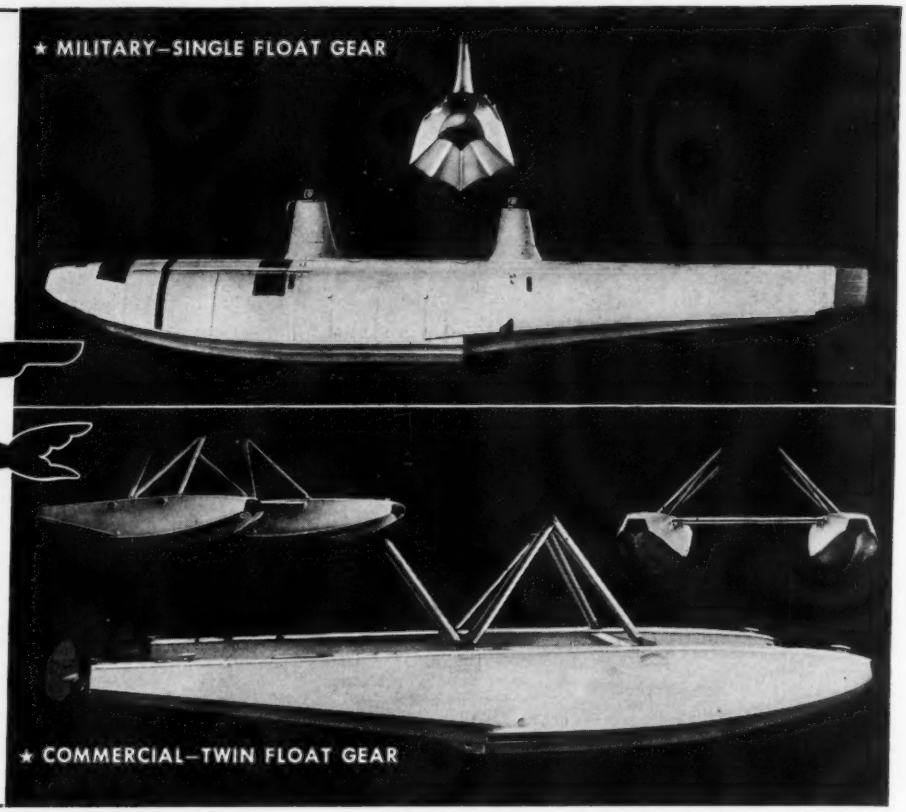

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The B. F. Goodrich Company
Goodyear Tire & Rubber Company

TOOLS

Cleveland Pneumatic Tool Company
Paramount Products, Inc.

TUBING (FLEXIBLE)

Breeze Corporations
Eclipse Aviation Division, Bendix Aviation Corporation

TUBING (RIGID NON-FERROUS)

Aluminum Company of America

TUBING (RUBBER)

General Tire & Rubber Company
The B. F. Goodrich Company

TUBING (STAINLESS STEEL)

Summerill Tubing Company

TUBING (STREAMLINE)

Summerill Tubing Company

VACUUM SYSTEMS

Simmonds Aerocessories, Inc.

VALVES & ACCESSORIES

Cleveland Pneumatic Tool Company
Eaton Manufacturing Company
Pump Engineering Service Corporation
Simmonds Aerocessories, Inc.
Thompson Products, Inc.
Westinghouse Electric and Manufacturing Company

WHEELS & BRAKES

Bendix Products Division, Bendix Aviation Corporation
General Tire & Rubber Company
The B. F. Goodrich Company
Goodyear Tire & Rubber Company
Simmonds Aerocessories, Inc.

FROM THE INDUSTRY

(*Continued from page 40*)

on the job result, Republic production men report.

Hitherto it had been necessary for a man working within the fuselage of an airplane on the line to crawl back to the first available opening if he had any instructions for the men working with him on the outside. It was extremely difficult for the superintendent or foreman to communicate with the man within the airplane. It meant halting some phase of a man's work while someone went into the interior.

Appreciating that in the course of a month, the time lost by employing such a method might amount to the time needed to get another Republic "Lancer" into the hands of the U.S. Army Air Force pilots, Republic production men devised the telephone system which eliminated such time losses. It is believed to be the first use of a telephone hookup on aircraft assembly-line production.

In order to obtain the equipment which would allow instantaneous communication between one or several points on an airplane, use was made of the standard Bell System operator's equipment, which is a covered light weight head receiver and chest transmitter, especially designed for clear transmission and freedom from noise. Regardless of the number of the units on the line, there will always remain an adequate amount of volume, provided by the desk set box containing an induction coil. The equipment used at Republic was especially designed for hard use and to stand up under the demands to which it is subjected as top-speed work goes on.

The Wilbur & Williams Company

Releases from the manufacturers of Dye-Crete, The Wilbur & Williams Company in Boston, state that this product makes it possible to dye concrete floors and coat them with alcohol and grease-resistant enamel within one hour. This recent development is said to counteract all of the four serious hindrances to color and dust-proof concrete floors.

Concrete is usually laid directly on, or close to, the ground. It therefore contains a certain amount of moisture—thus creating capillary action which tends to push the coating off. A second handicap, even on old floors, is that alkali reaction which, particularly in the presence of moisture, tends to soften any oil paints or varnishes, so that they cannot give a durable, hard finish.

Actual mechanical wear on the high spots of the concrete surface are a third hindrance to color and dust-proof, alcohol and grease-resistant concrete floors. Even two or three surface coats of ordinary finish will in time be worn down; the concrete color will show through and repainting will again be necessary. Finally, oils, greases, alcohol and various chemicals attack the usual types of paints.

Its makers report that Dye-Crete was developed to overcome each of these four influences which are constantly battling against permanent finish on concrete floors. Part of the Dye-Crete method is not a paint at all, but a stain which penetrates deeply into the concrete and becomes part of it. Even when the concrete wears down, it remains the same color to the depth of the Dye-Crete penetration. There is no way for this stain to be lifted or worn off until the floor itself is worn down.

REPUBLIC'S P-43 flashes through its paces on SHELL

100 OCTANE GASOLINE
...AND AEROSHELL OIL

LIKE a sleek silver bullet slashing through space, the new Republic Fighter P-43 does its stuff —its Pratt & Whitney Twin Wasp engine roaring, on Shell 100 Octane. The same fuel (produced commercially for the first time by Shell) that has made American military planes unexcelled in performance, speed and flying range.

No wonder those who know flying prefer Shell Aviation Fuel as well as AeroShell Oil.

Shell Oil Co., Inc., 50 West 50th St., New York, N. Y., or 100 Bush St., San Francisco, Cal.

REPUBLIC FIGHTER P-43
FlyingWeight—4,155 lbs. Length—28′ 5¾″. Span—36′. 1,200 H. P. Pratt & Whitney Twin Wasp Engine. Fuel—Shell 100 Octane. Oil—AeroShell.
REPUBLIC Uses Shell Aviation Products Exclusively

SHELL
AVIATION PRODUCTS

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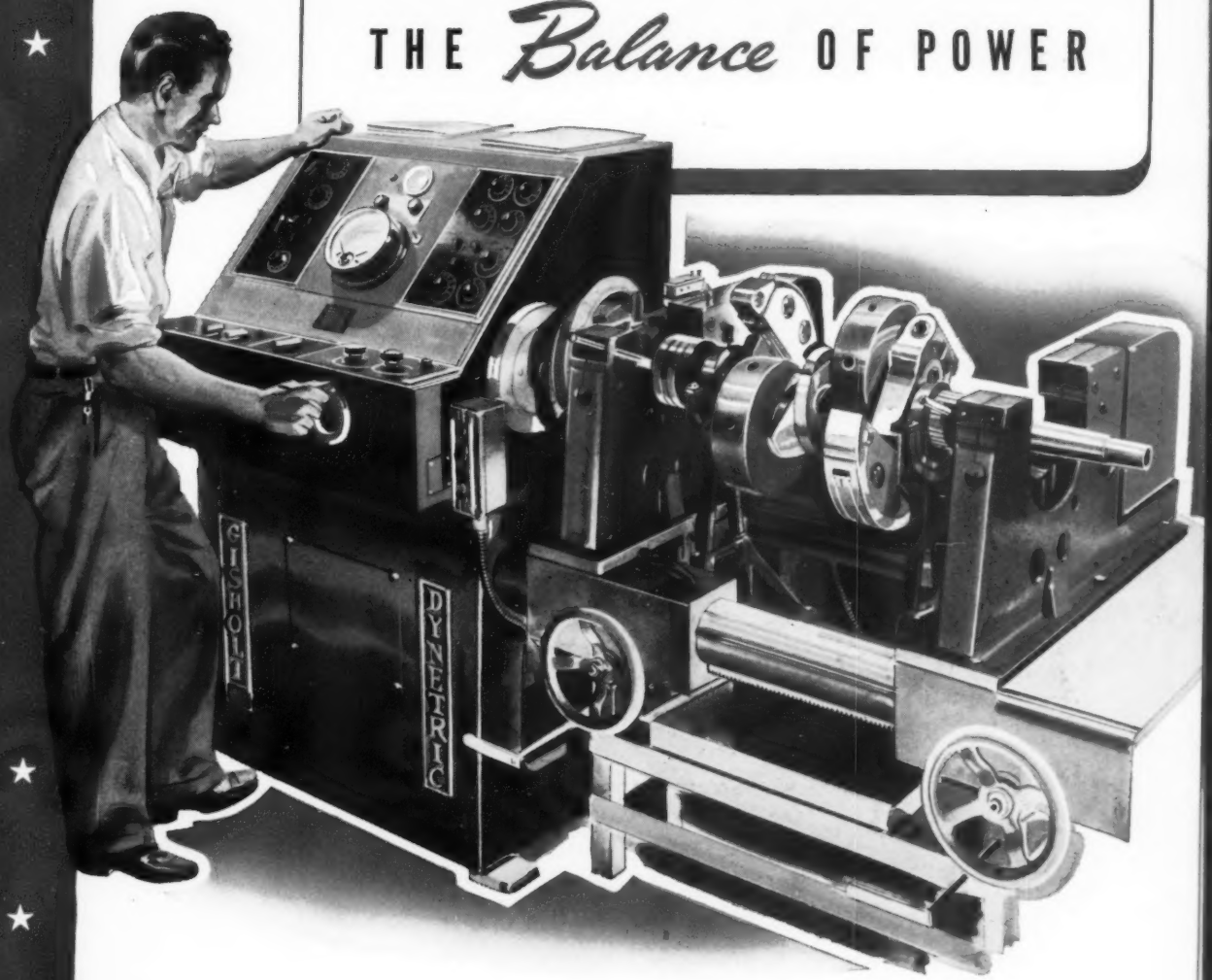
THE *Balance* OF POWER



AT a rate of 280 impulses per second, the cylinders of the Cyclone 14 aircraft engine deliver 1700 horsepower to the whirling crankshaft. With every revolution of this shaft, 14 sturdy pistons and rods accelerate up to 60 m.p.h. in a distance of 6 inches, then instantly reverse to complete the cycle. Under such conditions, operating smoothness requires the most precise balance of moving parts.

This even flow of power from a Wright engine is assured by checking every individual Wright crankshaft on a Dynetric Balancer. Accurate to the fraction of an ounce, this device determines not only the size of the counterweight required by a crankshaft, but also the exact point of application. With such precision equipment, Wright has maintained an unvarying standard of quality while defense output has increased nearly seven-fold to more than 1,750,000 horsepower a month.

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Aircraft ENGINES

WRIGHT AERONAUTICAL CORPORATION • PATERSON, NEW JERSEY

Division of Curtiss-Wright Corporation

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To meet the ever-increasing requirements of the aircraft industry, Eclipse Aviation has further increased production output not only by expansion of existing facilities, but by acquisition of carefully selected additional plants, capable of producing, under Eclipse supervision, parts and units in accordance with Eclipse specifications and quality standards.

Continued improvement and simplification of product design and standardization of production units are also important factors in speeding an uninterrupted flow of Eclipse Aircraft Accessory Units for National Defense.

At Left: Assembling Series 41 Direct Cranking Electric and Inertia Starters, Eclipse Production Department

Series 41 Direct Cranking Electric and Inertia Starter

ECLIPSE AVIATION
DIVISION OF
BENDIX AVIATION CORPORATION
BENDIX, NEW JERSEY, U. S. A.

Eclipse Aircraft Accessory Equipment: Engine Starters, Solenoid Switches, Booster Coils, Control Switches, Generators and Control Boxes, Radio Dynamotors, Supercharger Regulators, Electric Retracting Motors, Propeller Anti-Icer Pumps, Mechanical De-Icer Equipment, Air Pumps, Air Valves, Oil Separators, Hydraulic Pumps, Ammunition Rounds Counters and Contactors, Synchroscope, Fuel Flowmeters, Seamless Flexible Metal Hose, Ordnance Equipment, Magnesium, Aluminum and Non-Ferrous Sand Castings.